Concrete

Vol. 38 Chicago, April, 1931 No. 4

Bridge Piers in Suisun Bay Supply Test of Concreting Methods

Southern Pacific Railway Places 92,000 Yds. of Controlled Concrete—High Cement Factors Insure Density—Structures Reinforced Against Effect of Earthquake Shock

By C. R. HARDING
Assistant to President, Southern Pacific Company, San Francisco, Calif.

This story, presented in two installments, is one of successful achievement in maintaining field control of the quality of concrete under conditions that provided many difficulties.

Construction of the eleven main piers, eight of them in deep water, will be described in the next issue of "Concrete."

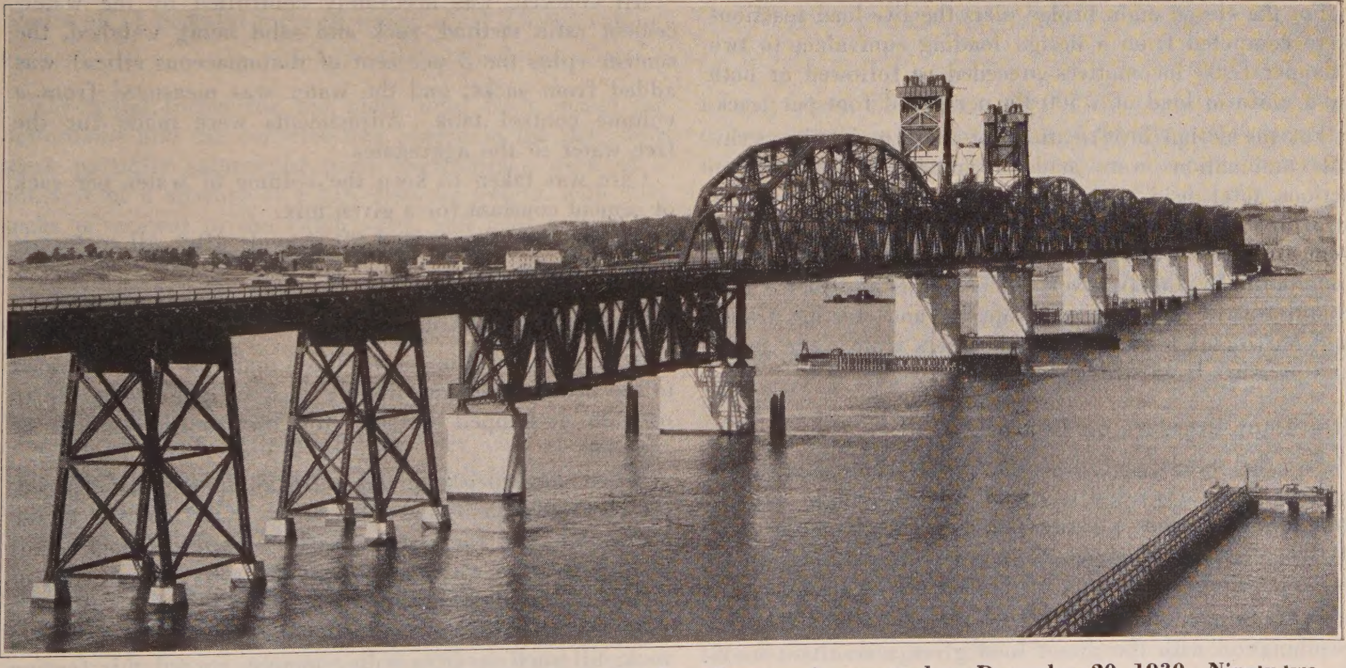
The story of this project gives the reader an inkling of the many demands on the ingenuity of the modern engineer who specializes in the design and construction of modern concrete structures.—The Editors.

THE Southern Pacific Company has replaced its well-known train ferry across Carquinez Straits with the longest and heaviest railroad bridge west of the Mississippi River, located about two miles east of the ferry crossing, spanning Suisun Bay, a part of the same branch of San Francisco Bay.

The bridge, of total length of 5603 feet, is made up of a combination of several types of spans. From the south bridge head there is a lineal length of 560 feet and from the north bridge head 220 lineal feet, of plate girder spans on steel towers, the columns of which rest on concrete pedestal piers.

Between these approach viaducts the spans consist of Warren trusses. Over shallow water at the south end is a 264-foot deck span, then toward the north a 526-foot through span, a vertical lift span 328 feet long followed by six 526-foot through spans, and a 504-foot deck span joins the north approach viaduct.

To support these spans a concrete substructure was built with the bases resting directly on the underlying bedrock and consisting of the following units:



The completed Suisun Bay bridge of the Southern Pacific railway, as it appeared on December 20, 1930. Ninety-two thousand cubic yards of concrete were required in the piers

(1) At the south and north bridge heads, massive U-type abutments.

(2) For the steel column footings of the south and north approach viaducts, twenty-two pedestal piers, fourteen of which had to be carried below low water line to reach bedrock for their footings.

(3) Eleven main bridge piers with rectangular bases entirely below the low water line. From the top of these bases, at elevation minus 20, to the bridge seats the pier shafts are tapered inward and are of an oval shaped cross-section, the rounded ends being on the up- and down-stream sides of shafts.

The concrete substructure units involved the placing of 92,000 cubic yards of concrete in a period of 15 months, from May, 1929, to August, 1930.

Bedrock Investigated

The piers are located on the line across Suisun Bay followed in preliminary investigations conducted in 1927. At that time eight diamond drill borings were made at intervals along this center line, penetrating deeply into the bedrock underlying the loose material in the bed of the bay.

Cores of this rock were obtained and tests made. Field tests were also made to ascertain the bearing value of material overlying the bedrock, and during construction these data were checked.

Design Loading

In addition to their own weight and that of the spans this substructure was designed to carry the reactions from certain specified engine and train loads on the superstructure.

For the viaduct approaches the live-load reactions on the abutments and column pedestal piers were calculated from the maximum concentrations due to a standard "Cooper's E60" loading.

For the eleven main bridge piers the live-load reactions were computed from a design loading equivalent to two "Cooper E90" locomotives preceded or followed or both by a uniform load of 7,500 lb. per lineal foot per track.

For the design investigations of these main piers critical combinations were made of maximum live-load reactions, total dead load of superstructure and of the substructure with and without allowance for buoyancy, together with the overturning effect of wind pressure, acting longitudinally and transversely, on spans and piers, horizontal tractive forces from stopping and starting trains, and horizontal forces against the piers from wave action and pressure from stream currents.

Resultant Pressure on Bedrock

For the tallest pier the calculations show that longitudinal forces (parallel to center line of bridge) cause a resultant maximum pressure on bedrock along the edge of the pier base of about 20 tons per square foot, which is well within the capacity of the bedrock to sustain.

From forces transverse to the bridge center line the combination with the direct load gives a resultant maximum pressure at the edge of the pier base of 16 tons per square foot.

Earthquake Tremors Considered in Pier Design

Examination by experts of the geological formations in this vicinity show the presence of faults of the earth's surface due to earthquake disturbances.

To prevent, if possible, the shattering of the concrete piers by such tremors, these large piers have been heavily reinforced throughout with steel rods, although ordinarily such reinforcement would not be used.

For the same reason the steel superstructure was anchored to the pier shaft by means of longitudinal and transverse angles projecting downward from the bottom of the steel truss span shoes and grouted into slots left in the top of the concrete bridge seats.

Assumed and Actual Strengths

For steel reinforcement under the assumed extreme conditions the allowable tensile value was set at 30,000 lb. per square inch and for the concrete the assumed unit strength in compression was 2,500 lb. per square inch at 28 days. Calculated unit stresses in the concrete were very much less than the assumed unit value, and the tests of material placed show that most of the concrete in this substructure has a value of 4,000 lb. to the square inch in compression at the age of 120 days.

Cement, Aggregates and Admixtures

The cement and aggregates were furnished by the railroad company, subject to inspection and tests.

The cement was bought from representative Pacific Coast mills under the A. S. T. M. specifications, modified to call for a fineness of 87 per cent passing a 200-mesh sieve. Each sack of cement was required to have 3 pounds of diatomaceous silica added by the cement companies at the mills.

For the aggregates a clean, well graded sand and crushed stone of excellent quality were supplied.

Control of Concrete by Modern Methods

All concrete was accurately controlled by the water-cement ratio method, rock and sand being weighed, the cement (plus the 3 per cent of diatomaceous silica) was added from sacks, and the water was measured from a volume control tank. Adjustments were made for the free water in the aggregates.

Care was taken to keep the volume of water per sack of cement constant for a given mix.

All concrete was mixed 90 seconds after all materials were in the mixer.

Construction of Abutments

At the south abutment all loose material was excavated to the bedrock and the sloping rock surface broken up to provide a stepped bearing for the footing course of concrete.

When the bedrock at the north abutment was exposed, the rock stratum, lying at an angle of 60 degrees to the horizontal, was found to consist of hard compact seams of rock between which lay seams of easily broken rock of doubtful bearing value.

It was considered wise to dig out much of this broken rock, fill such crevices with concrete, spread this footing over a larger area than at first planned, and use steel rod reinforcement to tie the mass of concrete together.

Wood forms were built, and 237 cubic yards of concrete were placed in the south abutment and 704 cubic yards in the north abutment.

A concrete mix, by weight, of 1-2.5-4.4, including five sacks of cement to the cubic yard, 6.75 gallons of water per sack of cement, was used. Samples taken during concreting were tested, and disclosed average compressive strengths of 2,000 lb. per square inch at 7 days and 3,200 lb. at the age of 28 days.

Tower Column Pedestal Piers

Of the twenty-two pedestal piers, eight are located on land and were built in wood forms, after the loose material had been excavated, the pier footings resting directly on the bedrock.

The concrete mix used for the footings and shafts of these land piers was 1-2.42-4.04, by weight, with 5.46 sacks of cement to the cubic yard, and 6.25 gallons of water per sack of cement.

Compression tests of this concrete show average strengths of 1,760 lb. per square inch at 7 days, 2,630 lb. at 14 days, and 3,350 lb. at 28 days.

For the fourteen pedestal piers in the water, rectangular cofferdams of timber ("Wakefield") sheet piling were driven through the mud to bedrock.

The mud and other loose material overlying the bedrock were dredged out with clamshell buckets, the cofferdams unwatered and braced with timber.

TABLE I—SUMMARY OF CONCRETE MIXTURES AND STRENGTHS IN ABUTMENTS AND PEDESTAL PIERS

Location	Proportions by weight except as noted	Sacks of cement per cu. yd. of concrete	Gallons of water per sack of cement	Average compressive strength, lb. per sq. in.		
				7 days	28 days	90 days
Abutments	1-2.5-4.4	5.00	6.75	2,000	3,200	—
Footings and shafts of 8 pedestal piers on land	1-2.42-4.04	5.46	6.25	1,760	3,350	—
Footings of 14 pedestal piers in water	1-2.07-3.46	5.96	5.78	2,500	3,400	4,100
Shafts of 14 pedestal piers in water	1-2-3 (by volume)	6.49	5.25	2,700	3,500	4,500

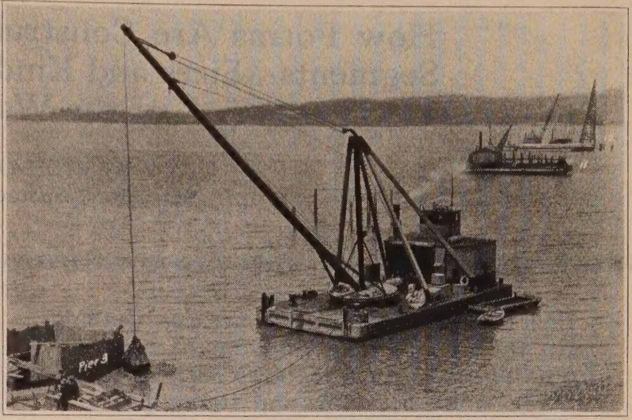
The wood forms for the piers were built inside the cofferdams and the concrete was placed in the dry. For these partially submerged piers the footings were of a concrete of a mixture of 1-2.07-3.46, by weight, with 5.96 sacks of cement to the cubic yard, and 5.78 gallons of water per sack of cement.

Compression tests indicated strengths of 2,500 lb. per square inch at the age of 7 days, 3,400 lb. at 28 days, and 4,100 lb. at 90 days.

The concrete for the shafts was a 1-2-3 mixture, by volume, with 6.49 sacks of cement to the cubic yard of concrete and 5.25 gallons of water per sack of cement. This concrete showed compressive strength values of 2,700 lb. per square inch at the age of 7 davs, 3,500 lb. at 28 days, and 4,500 lb. at 90 days.

Summary of Mixtures and Strengths

A summary of the concrete mixtures employed in the north and south abutments and the 22 pedestal piers is given in Table I, for the convenience of the reader. From this table it will be seen that, regardless of the high strengths attained, the cement factor was held at a high figure, especially in the piers in water. For instance, in the shafts of the 14 pedestal piers located in the water, where the concrete is in contact with both air and water, the cement factor is 6.49 sacks to the cubic yard of concrete. This insured a concrete that, for all practical purposes, is impermeable to water and should be durable.



General view at start of construction of main concrete piers, which will be described in detail in next issue

Construction of Main Piers

Construction of the eleven main piers will be described in the next issue of CONCRETE. The floating concrete mixing plant, the manner in which reinforced concrete caissons were sunk to bedrock, and the placing of concrete under water, are some of the features of special interest.

(*To be concluded in next issue*)

Spring Meeting of A. S. C. E. at Norfolk

The spring meeting of the American Society of Civil Engineers is scheduled to be held at Norfolk, Va., on April 15, 16 and 17.

The program arranged by the Virginia committee, aided by representatives from the entire southern region, includes a visit to historic Williamsburg to see the progress being made in the restoration of a number of old colonial buildings and other features associated with the colonial history of the city.

Dr. W. A. R. Goodwin, rector of old Bruton Parish Church, is in charge of the restoration program, one phase of which was described in the August (1930) issue of CONCRETE, pages 35-36.

Details of Movable Forms and Their Operation

How Forms Are Constructed—Laying Out Rings of Segments—Sizes and Kinds of Form Lumber—Details of the Working Deck

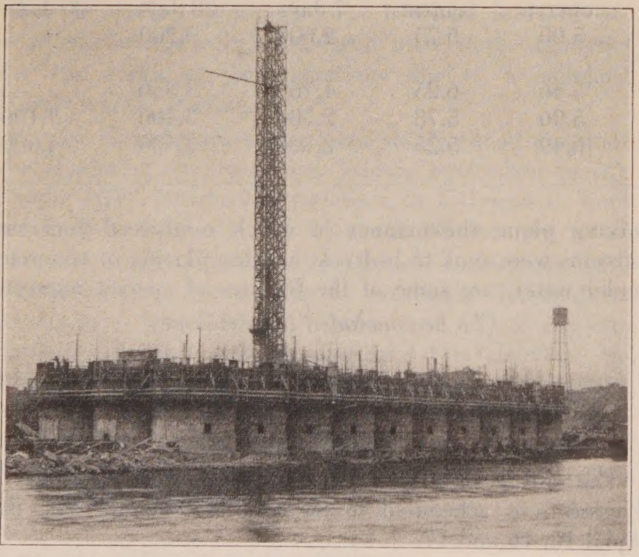
By RICHARD T. McKAY[1]
Masonite Corporation, Chicago, Illinois

Here is the first of two articles dealing with the details and operation of movable forms for concrete structures such as grain storage tanks, coal bins and standpipes.

The second article will describe the assembling, bracing and manipulation of movable forms, and further interesting details will be included.—The Editors.

THESE articles cover the design, detail and manipulation of moving forms as used by the majority of contractors. No consideration has been given to the several special features employed by various contractors, nor to the use of mechanical or hydraulic jacks. Hand jacks only are considered, since they are by far the most commonly used.

Moving forms have been in use for about 25 years. In their original conception jacks were placed under wall forms and the forms jacked up after the concrete had been allowed to set. The advantage of pulling the forms up while the concrete is setting, instead of pushing them, was obvious. This was the next step in their design and construction. This same principle is employed today.



Construction of concrete grain tanks illustrates typical use of movable forms

Moving forms are principally used in the construction of storage tanks, although they are also used in the construction of buildings where concrete frame and walls are placed monolithic and the floor slabs placed later. Greatest clarity can be obtained by an example of their design and manipulation. We will consider a group of eight concrete tanks with an inside diameter of 29 ft. 9 in., walls 7 in. thick and 100 ft. high.

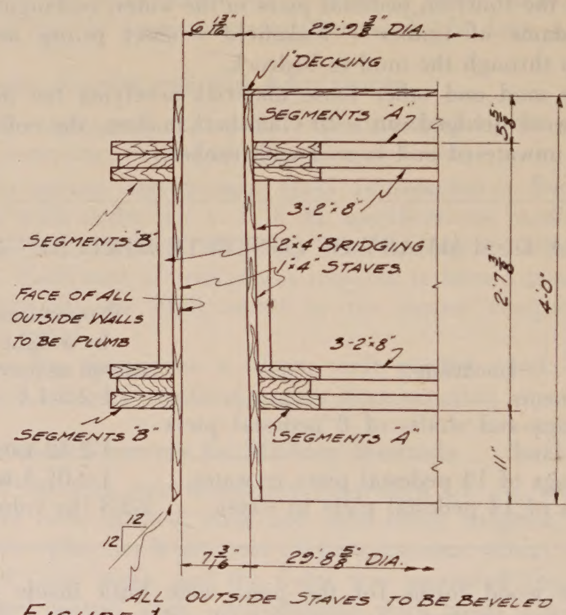


FIGURE 1— TYPICAL SECTION THRU FORMS

How Forms Are Constructed

The moving form proper is always built 4 ft. in height. The actual surface which bears against the concrete consists of 1 by 4-in. staves held near the top and bottom of their height by a ring of segments. The top and bottom rings of segments each actually consist of three rings of 2 by 8-in. segments. Figure 1 shows a typical cross-section through the form.

Careful study of Figure 1 will reveal the fundamental construction of moving forms. It will be noticed that while the tanks we are considering are to be 29 ft. 9 in. inside diameter, the diameters given at the top and bottom of the staves vary slightly from this figure. The lower

---

[1] Formerly with James Stewart Corporation, Chicago, Ill.

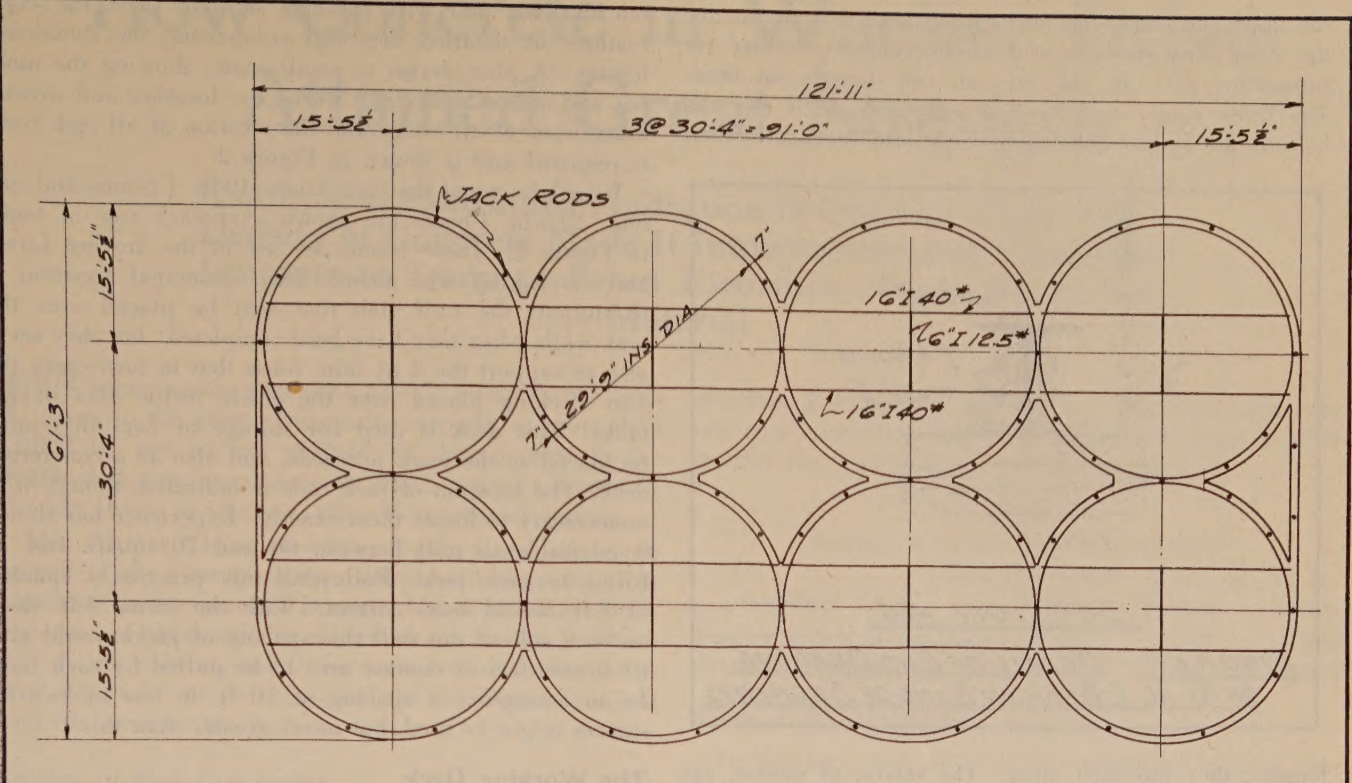


FIGURE 2—PLAN OF TANKS

82 JACKS REQUIRED

diameter is smaller and the upper one larger. This is done because it has been found easier to pull forms up when thus constructed and at the same time the mean thickness of the wall 2 ft. from the top of the form is 7 inches. As the concrete attains its set at about this point a 7-in. wall is satisfactorily obtained. The top of

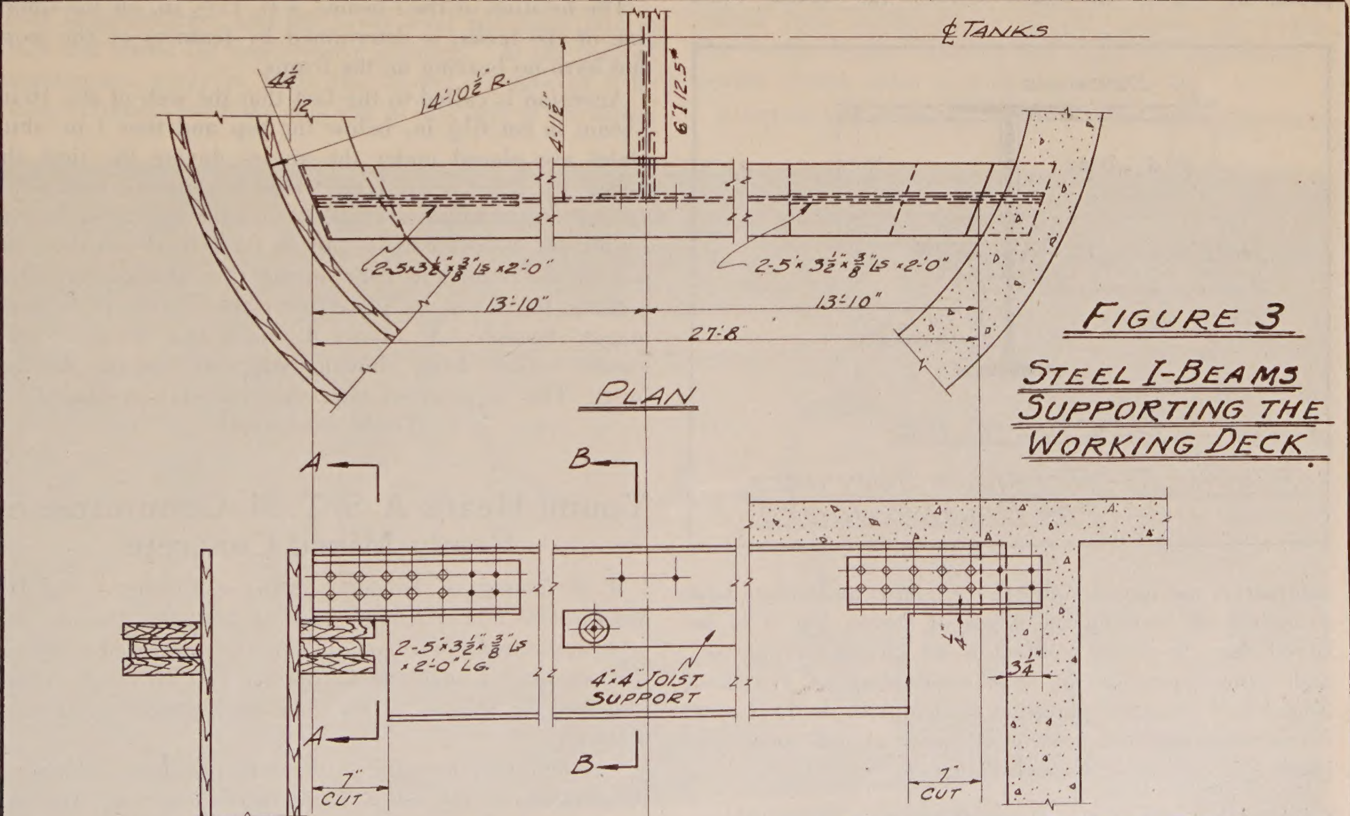
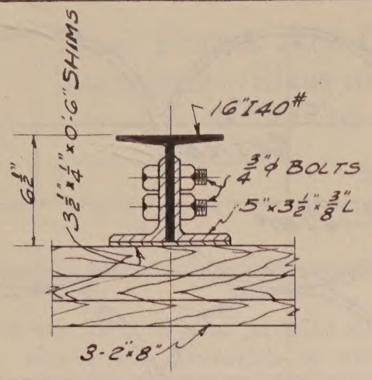


FIGURE 3

STEEL I-BEAMS SUPPORTING THE WORKING DECK

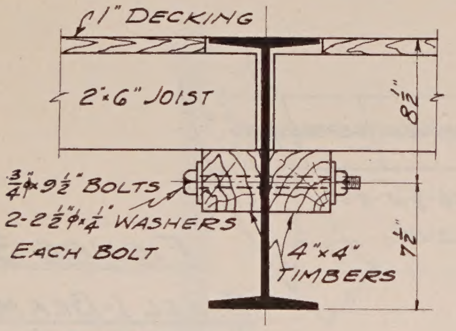
FOR SHIPMENT BOLT BOTH ENDS THUS. THIS DETAIL SHOWS BEAM AS PART OF FORMWORK.

THIS DETAIL SHOWS BEAM AS ROOF SLAB SUPPORT AFTER FORMS HAVE BEEN REMOVED. FINAL POSITION OF ANGLES the upper ring of segments is kept down 5⅝ in. so that the 2 by 6-in. joists spaced 16 in. center to center for supporting the 1-in. decking can rest directly on them. The three rings of 2 by 8-in. segments, both top and bottom, are spiked together and are laid so that, in their lengths, they lap each other. The staves, of course, are nailed to the segments. It is general practice in nailing the staves to the rings of segments to space the staves a distance apart equal to the diameter of a ten-penny nail. The carpenter, when nailing the staves to the segments, merely inserts a nail between them, top and bottom, thus getting the desired spacing. This allow the forms to expand when they are first wet and this swelling action practically closes the space between the staves. Some contractors use tongue and groove boards and others have a method of beveling the edges of staves, but it is believed that the above method is as satisfactory as any, and without question the most economical. A system of 2 by 4-in. bridging is placed at 45 deg. with the horizontal between the top and bottom segments as indicated, both inside and outside of the wall frame.



SECTION "AA"

FIGURE 4—DETAIL OF END BEARING OF 16-IN. I-BEAM ON RING OF SEGMENTS



SECTION "BB"

FIGURE 5—DETAIL OF SUPPORTS FOR DECKING JOISTS

General Layout of the Form Work

Now that a general idea of the construction of the form has been obtained, the first requirement is for a form layout drawing that will combine on one sheet the main features of detailed drawings comprising the remaining figures. A plan drawn to small scale, showing the number and size of tanks and walls, the location and overall dimensions of all tanks, and the location of all jack rods, is required and is shown in Figure 2.

It will be noted that two 16-in. 40-lb. I-beams and one 6-in. 12.5-lb. I-beam are shown over each row of tanks in Figure 2. These beams are set in the moving forms and carried up with them. Their principal function is to support the roof slab that will be placed over the tank walls when they have been completed; but they serve also to support the 2 by 6-in. joists that in turn carry the 1-in. decking placed over the entire inside area of the tanks. This deck is used for storage of bars that must be placed as the work proceeds, and also as a concreting deck. The location of jack rods is indicated, though it is unnecessary to locate them exactly. Experience has shown it advisable to pull between 60 and 70 square feet of forms to each jack. Following this practice a spacing of 8-ft. would seem correct. With the forms 4-ft. deep on each side of the wall this spacing of jacks would give 64 square feet of contact area to be pulled by each jack. In an emergency a spacing of 10 ft. in one or two instances might be used, but never greater than this.

The Working Deck

Figure 3 is a detail of the 16-in. I-beams referred to above. The 6-in. I-beam is used only to support the flanges of the 16-in. beams in a lateral direction. The detail is self-explanatory, showing as it does the arrangement of the angles when the forms are being pulled up and the arrangement when the beam is in its final position.

The location of the I-beams, 4 ft. 11½ in. off the center line of the tanks, is determined by features of the work that have no bearing on the forms.

Attention is called to the fact that the web of the 16-in. I-beam is cut 6½ in. below the top and that 1-in. shim plates are placed under the angles during the time the forms are being moved up. This is done so that when the top of the tanks is reached, and the two 5 by 3½-in. angles are removed to be put in their final position, the web of the beam will bear on the ring of segments, thus holding the beam in place until the operation is completed. Section AA, Figure 4, shows this detail clearly. Figure 5 is a detail showing supports for the decking joists. This is removed after the roof slab is placed.

(*To be continued*)

Young Heads A. S. T. M. Committee on Ready-Mixed Concrete

R. B. Young, of Toronto, testing engineer for the Hydro-Electric Power Commission of Ontario, Canada, has been appointed chairman of a newly organized technical subcommittee formed by Committee C-9 on Concrete and Concrete Aggregates, of the American Society for Testing Materials.

The new subcommittee will study problems relating to the production and use of ready-mixed concrete. The subcommittee has under way a specification which it is hoped will form the basis of a purchase specification covering this material.

How Concrete in Wacker Drive Attained Great Strength

Example of Continued Hydration in Outdoor Concrete—Density of Concrete Made It Impermeable and Therefore Immune to Damage From Elements—Facts About the Material

FOR some months past considerable publicity has been given to the great compressive strength of more than 11,000 lb. per sq. in. attained by the concrete in the double-deck reinforced concrete street structure known as Wacker Drive, in Chicago, after 46 months of service.

The Wacker Drive structure, built along the main branch of the Chicago River, was described in detail in CONCRETE in the issues of January, March and May, 1927. The first of these articles described the design and control of the concrete used, the second covered the structural design of the structure, and the third was concerned with the construction features.

Section of Slab Cut Away

The opportunity to test the strength of the concrete after some four years of service in a rather damp location along the river came in 1929 and 1930, when the city built a new bascule bridge at Wabash Avenue. The new bridge required the cutting away of a portion of the Wacker Drive structure. With this opportunity offered, 3-in. cubes of concrete were cut out of both the upper-level superstructure and the lower-level pavement late in 1929 and tested for compressive strength. At the time of construction, early in 1926, the 28-day strength of 6 by 12-in. cylinders from the concrete in this part of the superstructure was 2,620 lb. per sq. in. The 3-in. cubes, cut out and tested late in 1929 when the concrete was 46 months old, developed the following strengths:

TABLE 1

Strength of Concrete in Wacker Drive

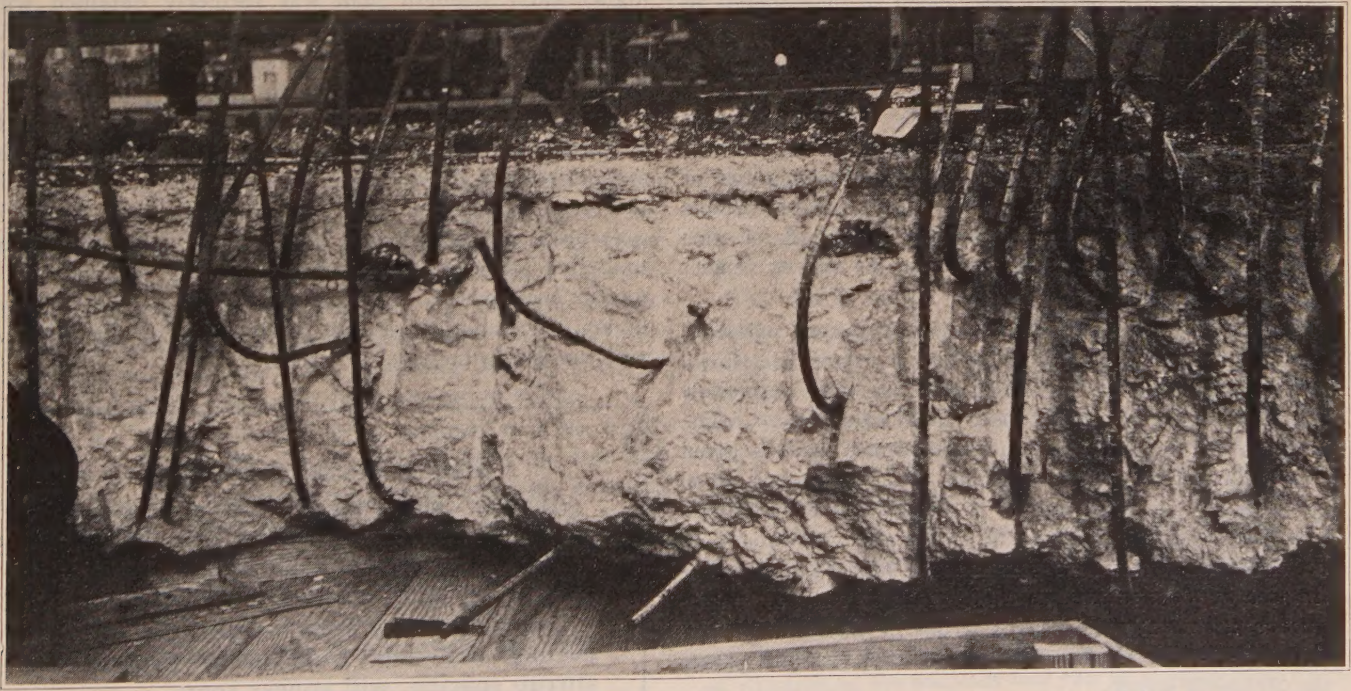
Location	Crushing Strength, in Lb. per Sq. In. Highest	Lowest	Average
Superstructure, 6 specimens	12,700	10,200	11,400
Pavement (lower level)	———	———	10,200

View of Freshly Broken Concrete

In the early fall of 1930 an additional area of the Wacker Drive superstructure was cut away. In the belief that readers of CONCRETE would be interested in the appearance of the freshly broken concrete, a member of the staff took a close-up photograph with a high-grade camera at a time when the light from the sun was in the right direction and was softened by a haze.

The photograph, reproduced below, shows clearly the high quality of this concrete, so far as quality can be judged from appearance. No void spaces are visible. The freshly broken concrete had much the appearance of freshly broken stone of great density.

From the three detailed articles in CONCRETE, previously



Close view of freshly broken concrete that tested 11,400 lb. per sq. in. Exposed steel bent up

mentioned, and from information supplied by Arthur R. Lord, consulting engineer, the following facts are determined about the concrete at this point in the Wacker Drive superstructure:

Aggregates. The fine aggregate was Beloit sand, with a fineness modulus of 2.8. The coarse aggregate was crushed limestone, with a fineness modulus of 6.6.

Proportions. The proportions, by volume, were 1-2.00-3.14, with 6.5 U. S. gallons of water to the sack of cement.

Admixture. Hydrated lime was added to the amount of 8 lb. to each sack of cement.

Date of Placing. This part of the superstructure was placed on January 6 and 7, 1926, as part of a continuous run started on January 4.

Temperature of Air. The air above the slab had temperatures ranging from zero F. to slightly below freezing.

Temperature of Concrete. Materials were heated. The temperature of the concrete was about 80 deg. at the mixer, 60 deg. at the forms, and from 35 to 40 deg. at the upper surface of the slab by the time it had set enough to permit covering with straw.

Heating. Salamanders held the temperature of the air beneath the slab at values ranging from 55 to 85 deg. F. during the 7-day curing period. Under the straw, at the surface of the slab, the temperature was well above 50 deg. F. during the curing period.

How Great Strength Is Made Possible

The great strength of this concrete demonstrates the possibilities of the material in outdoor locations, provided the concrete is not only strong, but also sufficiently dense to prevent damage from frost action, harmful gases or other destructive agencies.

Given concrete that meets the requirements of strength and density, an outdoor location where it receives frequent wettings from rain or fog, or where it is in direct contact with water, permits the cement in the concrete to undergo complete hydration.

The Process of Hydration

The process of hydration can be understood most clearly if the fineness, or size-distribution, of the cement is considered, particularly with respect to the quantity of extremely fine sizes present. The importance of fineness arises from the fact that, in general, the length of time required for hydration is shortened as the size of cement particles decreases.

The approximate size distribution of cement particles, and certain characteristics of the various sizes, are shown in Table 2. It is not pretended that this table represents an analysis of the cement used in Wacker Drive. The table merely represents the average cement, and is given as an illustration. It shows about what is obtained when an ordinary portland cement is separated into six sizes. The almost infinite fineness of the smaller particles may be visualized when it is remembered that 74 microns is the size of the openings in a 200-mesh screen. In consequence, a cement particle 10 microns in diameter has less than one-seventh the diameter of a particle that just passes the 200-mesh screen.

TABLE 2

Approximate Size Distribution of Portland Cement

Size of Cement Particles, in Microns[1]	Per Cent of Total[2]	Color	Time Required for Complete Hydration[3]
Minus 10	21	Pure white	Less than 24 hrs.
10 to 20	16	Nearly white	24 to 48 hrs.
20 to 30	8	Very light brown	4 days
30 to 43	30	Light brown	7 days
43 to 74	16	Brownish gray	28 days or longer
Plus 74	9	Gray	Indefinitely long

---

[1] Openings in the 200-mesh and 325-mesh screens correspond to 74 and 43 microns, respectively.

[2] Approximate percentages only, of an average portland cement.

[3] Approximate time only.

Reference to the last column in Table 2 reveals an interesting story about the hydration of cement, and consequently about the hardening of concrete.

What happens is that in building construction work as ordinarily built only three of the fine sizes, representing about 45 per cent of the quantity of cement, have time to become completely hydrated during the short curing period and before the remaining water is dried out. The structural concrete is then covered up in the construction process and the three larger sizes, representing about 55 per cent of the total quantity of cement, never do become completely hydrated, although the 30-43 size will have undergone some action.

In outdoor concrete, however, subsequent periods of rainy weather supply the moisture that causes a resumption of the process of hydration of the coarser particles, and eventually all the cement becomes hydrated and the full strength of the concrete is attained.

Table 2 explains further how a number of cement manufacturing companies have succeeded in obtaining higher early strength than was formerly obtained with ordinary portland cement. They have accomplished it, at least in part, by greater fineness, and more especially by increasing the percentage of the smaller particles.

Another point emphasized by Table 2 is that very little is known about the fineness of cement when only the amount passing the 200-mesh screen is known. To specify that cement shall be such that not more than a certain percentage is retained on a 200-mesh screen is like trying to define sand by stating the percentage retained on a quarter-inch screen. In neither case is anything known about the gradation or size distribution of the material with respect to the smaller sizes.

Short-Cuts in Design

Another chart that provides a short-cut in structural design, prepared by James R. Griffith, appears in this issue. Additional ones by the same writer are coming.

Other charts, by other writers, two of them dealing with the troublesome problem of stirrup spacing, will appear soon.

Profitable Manufacture of Concrete Building Units

Analysis of Several Economical Raw Material Handling Methods—Sketch Layouts Illustrate Discussion—Labor Rates Assumed—Cost and Depreciation of Facilities

V—Handling and Storage of Raw Materials

Part I

By FRED A. SAGER
Consulting Industrial Engineer

A NUMBER of methods of handling raw materials are used in existing plants today and a few of these will be considered for the purpose of illustrating the method of analyzing the cost of this part of plant operation. For this discussion, sketch layouts shown in Diagrams 6, 7 and 8 have been prepared, in general conformity to the Preliminary Block Plan, Diagram 5[1] and suitable for handling the annual production shown in Table III.[2]

THE great practical value of the present series of articles by Fred A. Sager has already been demonstrated. Managers of concrete products manufacturing plants tell us the information supplied by this writer rings true.

The present installment, and the one to come in the May issue, deal with the handling and storage of raw materials.—The Editors.

The problem in general is that of handling bulk or package goods in the most convenient and economical manner, from the point of receipt to the point of storage, or to the point of manufacture. The rehandling from storage to point of manufacture is properly chargeable to manufacture, but as the location of the storage affects both the direct handling and the rehandling costs, the entire matter may well be studied as one operation, in considering the matter now in hand.

The sketch layout of Diagram 6 provides for the unloading of cars of aggregates by shoveling into storage piles as ordinarily found in many material yards. Bin sides, 10 ft. high, are shown to retain the material alongside the railroad siding, and bin sides at right angles to the siding to separate the materials. In this case the handling operations from car to mixer are (A), shoveling from car to pile, and (B), shoveling and wheeling in wheelbarrows or wheel cart from storage to mixer.

For the latter operation it is assumed that the mixer receives the aggregate at the floor level, as is the case with certain types of manufacturing equipment with elevating batch buckets. In case materials are delivered to the mixer 3 to 5 feet above the floor level, corresponding adjustments would have to be made in the costs figured below.

The arrangement in the sketch layout, Diagram 7, allows the aggregate to be discharged by gravity from the car into a receiving hopper, from which it is carried by the elevator and dropped into the storage bins as Operation (A). As shown in the sketch elevation, Operation (B) consists of shoveling down from the bin into the batch box of the mixer. In such a layout, with bins well filled, material is always at hand for easy and rapid handling. Where bins are less than one-third full, this shoveling operation is slower, and with nearly empty bins it becomes similar to the operation with the storage piles, Diagram 6, but with a shorter haul.

Elevated Aggregate Bin

The alternate elevation, Diagram 7, shows what amounts to an elevated aggregate storage bin, if the mixer receives its materials at the floor level. Since all aggregates stored can be delivered into measuring boxes by gravity, and with a short haul delivered to the mixer, no hand shoveling is required. This layout provides space under the aggregate storage for the fuel supply, in which case the ground occupied by the plant, as shown in the plan, can be reduced by one panel 20 sq. ft. in size.

The sketch layout, Diagram 8, provides full elevated storage for aggregates, the car unloading operation (A) being the same as in the previous layout. In this layout the mixer would be on a level above the block machines, and would be served by measuring boxes, receiving aggregates by gravity from storage.

Assumed Labor Rates

A comparison of the methods of operation for a plant in a given locality can be made only when the conditions applicable to that locality are known. The class of labor available and the wage paid must be known for a definite conclusion in any specific case. Therefore, for the purpose of illustrating the methods that can be applied in any case and for any type of operating conditions the above operating conditions have been selected. For cost estimates, a rate of 75 cents per hour is taken for labor and a labor performance as stated below. On these assumptions the costs for the various operations considered are shown in Table IV, Operating Cost of Handling Cinder Aggregate.

---

[1] Page 25, March issue of CONCRETE.

[2] Pages 28 and 29, February issue of CONCRETE.

In the case of shoveling cinders to storage piles, a rate of 4 yds. per hour or 6,000 lbs., is taken, which, with a labor rate of 75 cents per hour, directly gives the cost of 12.5 cents per 1,000 lbs. as the cost of putting the cinders into storage piles. For handling sand or stone as aggregate, suitable labor performance, as is applicable to those materials, should be used. And, of course, labor wages from 40 cents or less per hour up to 90 cents per hour will be found in various parts of the country.

Analysis of Wheeling Costs

For the operation of wheeling from the storage pile to the mixer, with 2¼ cu. ft. capacity wheelbarrows, an average run of 50 ft. is taken [(B) in Diagram 6]. The time for filling one wheelbarrow is taken at 40 seconds, wheeling, dumping and returning 60 seconds, or at a rate of 36 trips per hour, which moves 81 cu. ft. (3 cu. yds.) or 4,500 lbs. per hour. This produces a cost of 16.66 cents per 1,000 lbs.

If, however, use is made of a wheelbarrow of 3 cu. ft. capacity, the filling time is taken at 60 seconds, the wheeling and dumping, as before, at 60 seconds, and the trip time is 2 minutes, or 30 trips per hour, handling 90 cu. ft. (3⅓ yds.) or 5,000 lbs. at a cost of 15 cents per 1,000 lbs. A decrease is shown in cost, with a shoveling rate slightly lower than that of the former case.

If, now, a wheel cart of 9 cu. ft. capacity is used, with a low-hung body, so that the cinders can be shoveled down into the dump body, and the filling time is taken as 3 minutes, hauling and dumping 1 minute, making the

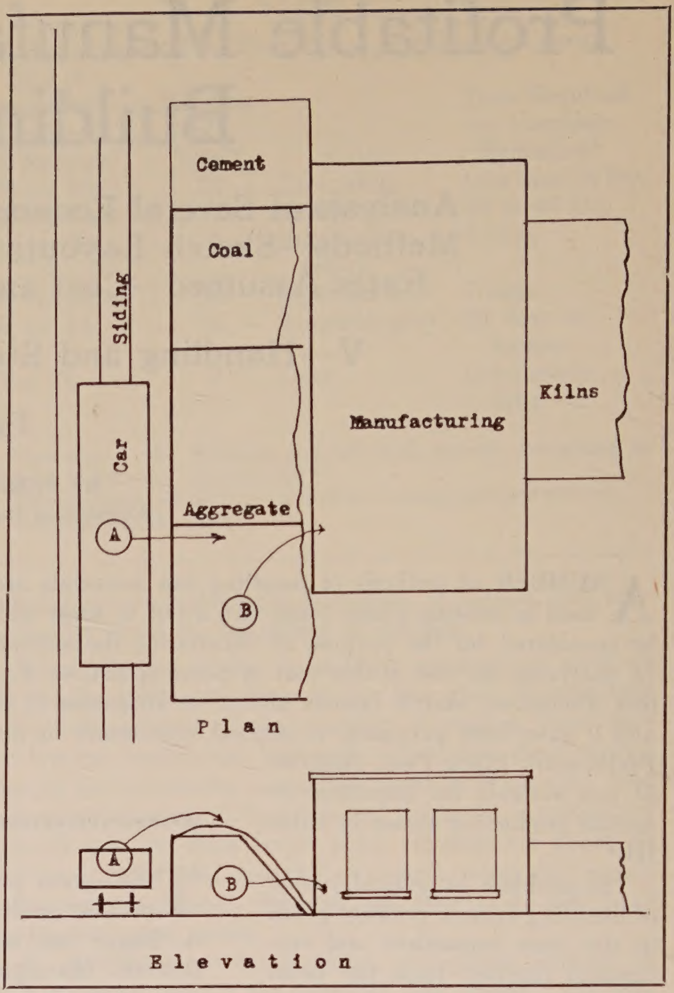


Diagram 6. Sketch layout. Raw materials placed in storage by hand

Operating Cost of Handling Cinder Aggregate.

Movement	Quantity Handled Cu Yds	Pounds	Time in Hours	Cost		Cost per 1000 Pounds
Car to Storage Piles by shoveling	4	6000	1	1 Hour Labor	$0.75	12.5¢
Storage Pile to Mixer in 2¼ cu ft wheel barrows	3	4500	1	1 Hour Labor	0.75	16.66¢
Storage Pile to Mixer in 3 cu ft wheel barrow	3.33	5000	1	1 Hour Labor	0.75	15.0¢
Storage Pile to Mixer in 9 cu ft wheel cart	5	7500	1	1 Hour Labor	0.75	10.0¢
Bins to Mixer, shoveling down.	10	15000	1	1 Hour Labor	0.75	5.0¢
Elevated Bins to Mixer with 9 cu ft measuring box	20	30000	1	1 Hour Labor	0.75	2.5¢
Elevated Bins to Mixer with 18 cu ft meas. box.	40	60000	1	1 Hour Labor	0.75	1.25¢
Car to Bins with Elevator Equipment	73.5	110000	4	5 Hours Labor 20 kw hrs	3.75 1.60 5.35	4.85
Car to Bins with Elevator Equipment through Screens and Crusher	73.5	110000	4	8 Hours Labor 60 kw hrs	6.00 4.80 10.80	9.85

Table IV. Operating Cost of Handling Cinder Aggregate

total trip time 4 minutes, the performance is 15 trips per hour, or 135 cu. ft. (5 cu. yds.) or 7,500 lbs., at a cost of 10 cents per 1,000 lbs. The shoveling rate here is about 18 per cent above the usual rate into wheelbarrows.

Time Saved by Proper Runways

From these comparisons it is evident that attention should be given to such simple operations of hand labor. Proper runways for ease in wheeling and dumping will be effective in reducing the cost of such operations, and the size of the load wheeled should be made as large as can be expeditiously handled over proper runways. The quantities of each of the different sized aggregates entering into each batch have to be considered as well.

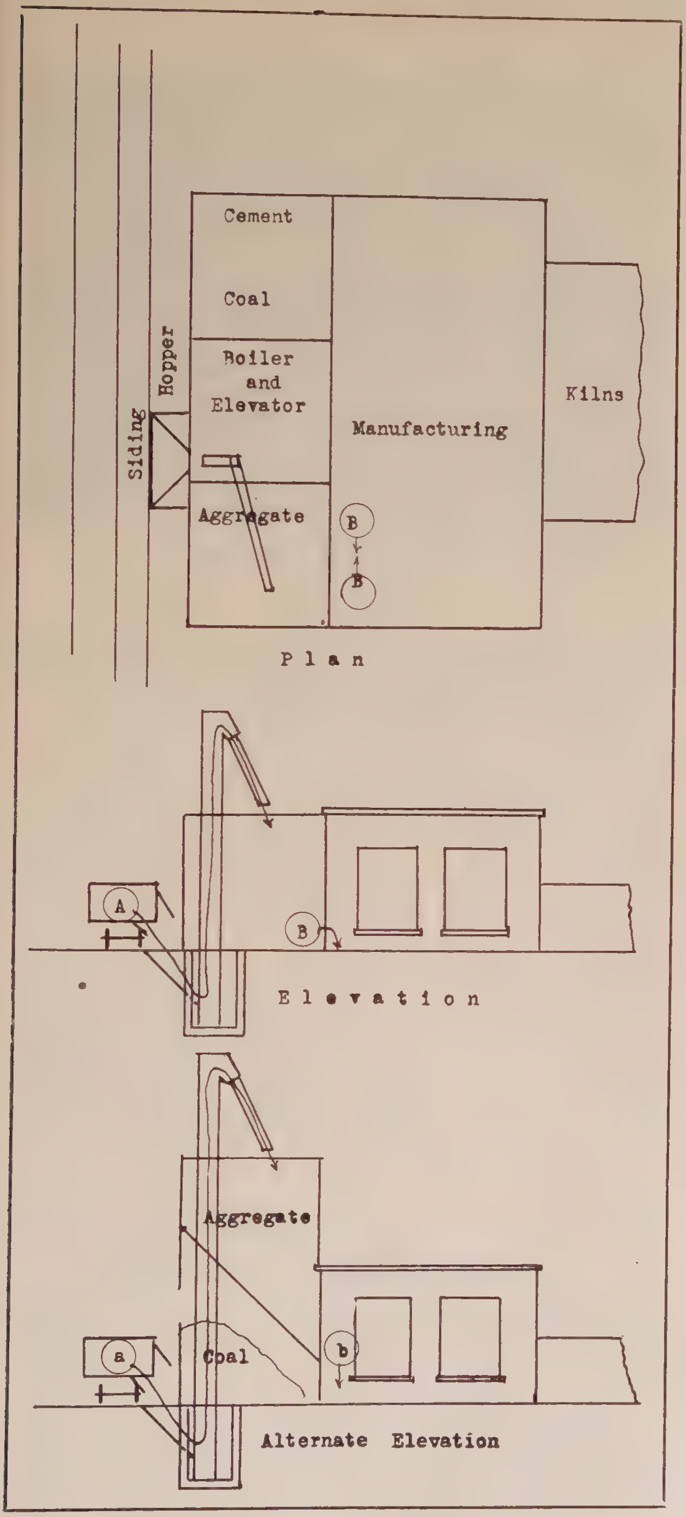


Diagram 7. Sketch layout. Aggregates placed in storage by elevator with bins on the ground. The alternate elevation shows the aggregate bin partially elevated

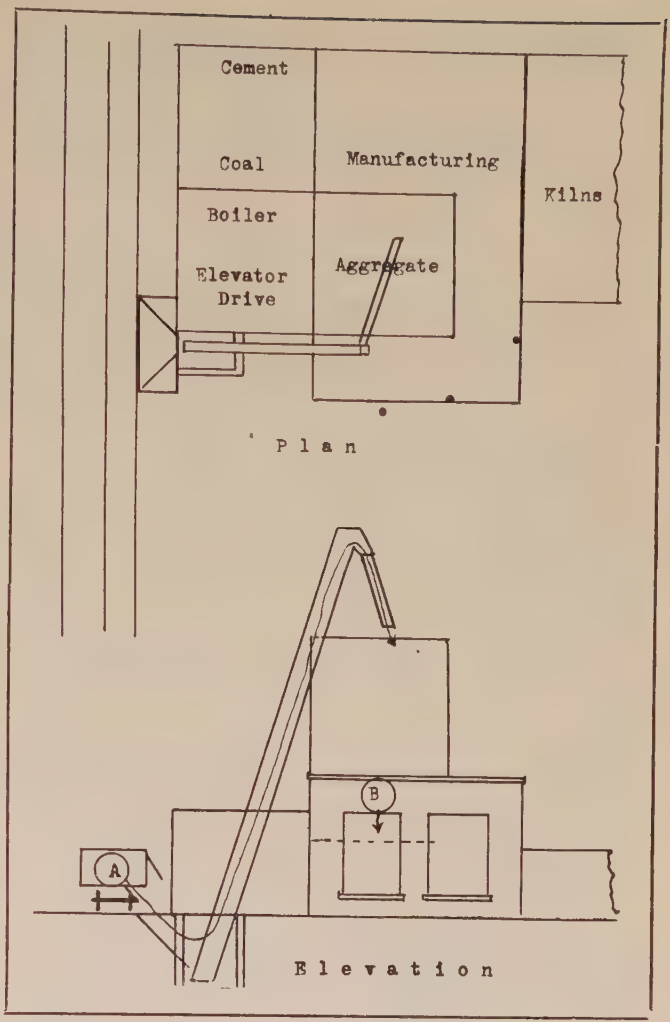


Diagram 8. Sketch layout. Aggregate put into full elevated bins

In the operation of shoveling down into the batch box of the mixer (B), Diagram 7, the rate is taken as 9 cu. ft. in 2 minutes, nearly twice the rate of shoveling into the ordinary wheelbarrow. This rate, and better, has been maintained in regular operation. The operation was intermittent, as other work, such as handling cement and water for the mixer came in rotation, and as the material in the bins is usually above the batch bucket, the easy shoveling results in a higher rate for the operation. The rate in this case is 270 cu. ft. (10 cu. yds.) or 15,000 lbs. per hour at a cost of 5 cents per 1,000 lbs.

Time of Aggregate Handling

In case of handling aggregates from the elevated bins to the mixers (Diagram 8), it is assumed that the material is delivered through a cut-off gate to the measuring box, suspended on a monorail or mounted for easy wheeling from gate to mixer. Assuming two batches taken, one fine and one coarse, for each batch of 9 cu. ft., each taking 10 seconds, and that each movement of the measuring box, from the mixer to the first gate, first gate to second gate, second gate to mixer, takes 10 seconds, the total is 50 seconds. Allowing another 10 seconds for dumping and as a margin, the total of 1 minute is taken for the operation, or a rate of 9 cu. ft. per minute, 540 cu. ft. (20 cu. yds.) or 30,000 lbs. per hour, at a cost of 2.5 cents per 1,000 lbs. If the equipment is designed to serve a 2-bag mixer, twice the quantity can be handled per batch in the same time, at a cost of 1.25 cents per 1,000 lbs.

Separate Charge for Each Operation

In many of these operations it is understood that the work on the operation is not continuous, and that other work is done between the operations figured here. A question may be raised as to the use of such a method in figuring costs. The method clearly assumes that the time of the laborer is fully used on various operations, and if the work cannot be so laid out, such lost time will be added to the total cost of plant operation. But for the purpose of comparing the relative cost of operation by different methods, the separate charge for each operation should be used.

Next month we will continue with the handling and storage of raw materials, including a discussion of the cost of facilities.

Reclaim Land for Baltimore Airport With Concrete Bulkhead

Special Cement and Rich Mixtures of Concrete Employed—Structure Supported on Piling

A concrete bulkhead, 4,500 ft. long and supported on piling, has been completed as a part of the development of unit A of an airport project at Baltimore. The site of the airport is on the north bank of the Patapsco River, near the southeastern limits of Baltimore, and immediately south of where Colgate Creek empties into the Patapsco. Unit A comprises 380 acres.

Inside of concrete wall that serves as bulkhead

Placing Fill Behind Bulkhead

The maximum distance from the original shore line to the bulkhead is 1,200 ft. The area behind the bulkhead is being filled by dredges, the maximum depth of fill being 20 ft. It is expected that several years will be required for the completion of the fill. While the three dredges working on the fill have a combined 24-hr. capacity of 29,000 cu. yd., and are averaging around 20,000 cu. yd. daily, the total fill required is estimated at 12,000,000 cu. yd.

Dimensions of Bulkhead

A typical cross-section of the concrete bulkhead measures 4 ft. 6 in. high, 3 ft. across the top, and 4 ft. 6 in. across the base. The entire batter is on the inside of the wall, the outside face being vertical. The bulkhead rests on a wooden deck placed at a level of 1 ft. 6 in. below mean low water, and the deck, in turn, is supported on wooden piling. The average distance between mean low water and mean high water at this point is 14 in.

View of completed wall, with airport buildings in left background

Employ Rich Mixture

The concrete for the bulkhead was mixed in the proportions of 1:1.8:2.7. Because of the presence of sea water the cement employed was the special type known as Super Cement, supplied by the Lawrence Portland Cement Co.

Contractors and Engineers

The general contract on this airport project is held by the Empire Construction Co., of Baltimore, and this company built the concrete bulkhead. E. E. Hammond, harbor engineer for the city, is in direct supervisory charge of the work, and H. W. Morgan is resident engineer. C. Fred Goob is chief engineer in general charge of the work.

Concrete Reinforcing Manufacturers Hold Meeting in Mississippi

The seventh annual meeting of the Concrete Reinforcing Steel Institute was held at Biloxi, Mississippi, March 16 to 18.

At the annual election O. W. Irwin, of the Truscon Steel Company, Youngstown, was elected president; Charles M. Gunn of Gunn, Carle & Company, San Francisco, was elected vice-president; Hugh J. Baker, of Hugh J. Baker & Company, Indianapolis, was re-elected as treasurer, and M. A. Beeman and R. W. Johnson were re-elected secretary and engineer.

Concrete Mixture Design Controlled by Chicago & North Western

Detailed Instructions Issued to Contractors—Quantity of Mixing Water, Yield of Mixture and Proportions for Trial Batches Shown on Diagram

By O. F. DALSTROM
Engineer of Bridges, Chicago & North Western Railway, Chicago, Illinois

This third and final installment of this valuable series of articles on the quality control of concrete comprises the "Instructions for Designing Concrete Mixtures" issued by the Engineer of Bridges of the Chicago & North Western Railway for the information of contractors, and for the use of the railway company's engineering and inspection forces.

Previous installments, in the February and March issues, described the manner in which quality control methods for concrete work were established by the Chicago & North Western, and the instructions issued to the railway company's inspectors.

In the presentation of these articles, CONCRETE has been privileged to give publication to what is probably the most clear-cut description of modern concrete-making methods thus far published. The methods described and the instructions given would seem to be models of procedure for others to follow.—The Editors.

As an aid to the practice of making concrete and to establish a uniform system of recording data and designing concrete mixtures on the C. & N. W. Ry., a form has been prepared, known as Form BD-1. It is intended to be used whenever concrete is made. One copy of each form properly and completely filled out for each class of concrete designed on the job shall be sent to the Engineer of Bridges as soon as concrete work is started, or before, if the materials for the concrete are on hand, so that this information will be on hand when the report of test of the first specimen is received.

In preparing this form, field conditions have been constantly in mind, and calculations have been avoided wherever possible. While there is no objection to designing concrete mixtures by trial, it has been found by making a large number of tests that the method outlined on Form BD-1 gives a more definite starting point with the least amount of time and effort. Also the data to be recorded thereon will be of inestimable value in the analysis of results and as a guide for future practice.

The source of aggregates shall be determined and recorded on the form. Experience with aggregates in any territory furnishes an index of its value for future work. If aggregates pass these tests, but concrete made with them has weathered badly, we must be cautious. Vigilance should never be relaxed, because past behavior, although a good index, is not a guarantee. Improper practices may have been the cause, but it may be wise to have the engineer of tests make a soundness (Braris) test.

One of the most dangerous ingredients to be found in aggregates can not be detected by the eye; i. e., organic impurities, such as tannic acid and its salts in sand and gravel. This is seldom found in crushed stone. Generally, the sand will have a common origin with the gravel and a test of the sand will serve for both. This test is known as the colorimetric or color test, and is made as follows:

One ounce of caustic soda (sodium hydroxide,

Track crane placing concrete for bridge piers, with a bottom-dump bucket procurable at most drug stores) dissolved in one quart of water, preferably distilled, makes the testing solution. This solution should be kept in a bottle with a glass or rubber stopper, as the solution will eat the cork and become discolored. A little of the sand is dried in a pan with moderate heat and allowed to cool. Into a 12-oz. prescription bottle, such as druggists use, enough of the dried sand is poured to stand to the 4½-oz. mark. Testing solution is added until the volume of sand and solution, after shaking, amounts to 7 ounces. After the bottle has stood for 24 hours the color of the clear solution is compared with the color chart. Unless the color is satisfactory beyond any doubt, the test should be checked to be sure. If the color shows up bad or doubtful

FORM BD-1

C. & N.W. Ry.

CONCRETE MIXTURE DATA AND DESIGN

Location ______________________ ______________ Division

Description ______________________ Bridge No. __________

Source of Aggregates: Fine ______________________ . Color test ______ Silt test ______

Coarse ______________________

Contractor ______________________

Weather ______________________ Date __________

Specifications: Strength ______ lbs.: Water ______ gal. (W): Slump 1" to 3" Made by __________

GRADING		
SIEVE	FINE	COARSE
1½"	----	
¾"	----	
⅜"	----	
#4		
8		100
14		100
28		100
48		100
100		100
TOTAL/100	Gf	Gc

PROPORTIONS

a Weight per cu. ft. - field measure Fine __________ Coarse __________

b Pounds of aggregate (from diagram) __________

c Grading "G" (from diagram) __________

d $\frac{Gc \quad -G}{Gc \quad -Gf}$ = ______ = ______ fine. 1.0 − fine = ______ coarse

e Trial Mix by weight (b × d) 94: ______ : ______

f Trial Mix by volume (e ÷ a) 1: ______ : ______

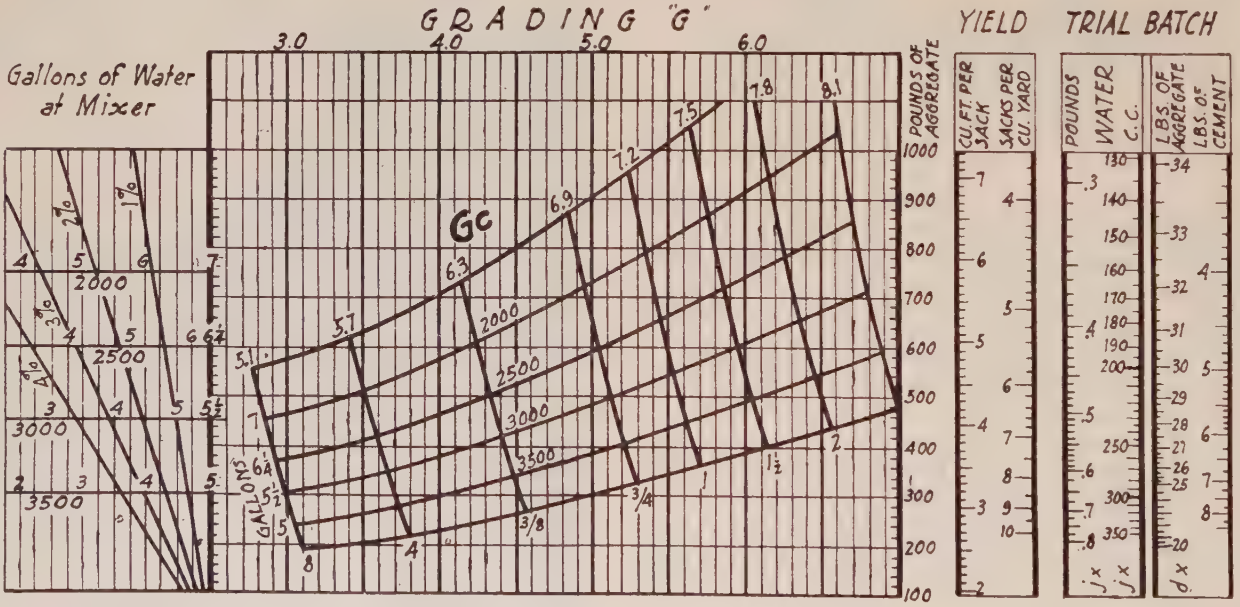
WATER

g Per cent of free water in aggregates in ratio (d) (% - 1) ______

h Gallons of free water (0.12 × b × g) ______

j Gallons of water required at mixer. W ______ − h ______ = ______

For diagram, Gc ____, reduced 0.1 for each 5 lbs. coarse aggregate (a) is less than 100 lbs.



Trial mix should be adjusted at the mixer. Water should be checked frequently.
To increase slump 3," reduce aggregate 100# and add 0.1 to "G".
If mix seems undersanded, reduce "G" 0.1 and weight of aggregate 20# until O.K.
Diagram is based on aggregate having a solid weight of 165 lbs. per cu. ft. Lighter material will require a proportionate reduction in weight used.

Fine __________
Coarse __________
Cement __________
Water __________

Form BD-1, containing diagrams used in designing concrete mixtures

> again the sand should be rejected. If the solution is almost perfectly colorless it is rated "OK." If it is about the color of No. 1 it is rated "OK 1," or if it just qualifies, such as No. 2, "OK 2." If it is darker than No. 2, the sand shall not be used unless it meets the requirements of Clause No. 14 of "Specifications for Masonry."

Testing Aggregates for Cleanness

The next step is to see that the aggregates satisfy the specification requirements, as to structure and cleanness. Structural qualities can best be determined by a hammer. The depth of the "mud ring" in the color test is an indication of cleanness. For instance, if it is as deep as that shown in Bottle No. 2 of the color chart, the following test should be made:

> Pour cool dried sand to the 14-oz. mark into a 32-oz. graduated prescription bottle, and then pour in clear water up to the 28-oz. mark. After shaking vigorously, allow the bottle to stand for one hour. If more than 1 oz. of sediment appears, the sand is unsuitable. If the result is doubtful, a check test should be made. The result is to be entered as "OK" or "Rejected" opposite "Silt Test."
>
> Spaces for "weather" should be filled out, recording the average temperature and whether raining or dry weather is prevalent. The former may affect the strength of the concrete, the latter the condition of the aggregates.

Classes of Concrete

The concrete is noted on the plans as Class A, B or C concrete. The strengths at 28 days should be: Class A, 3,000 lbs. per sq. in., requiring a maximum of 5½ gallons of water per bag of cement; Class B, 2,500 lbs., with 6¼ gallons of water; Class C, 2,000 lbs., with 7 gallons of water. The proper figures are entered on the form and the design proper is then proceeded with.

Sampling the Aggregates

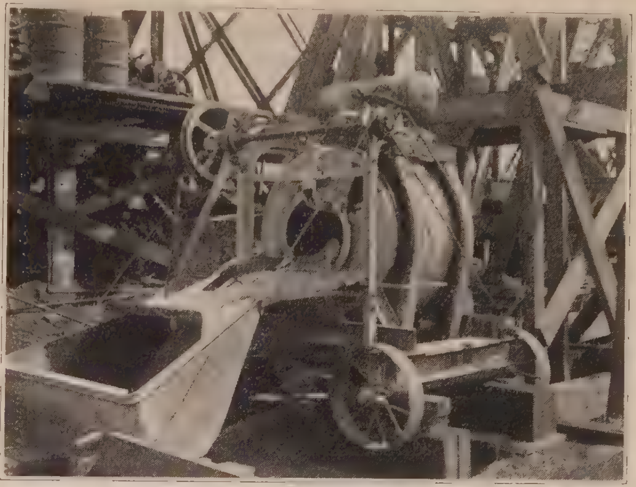
The most careful analysis means little unless a representative sample is obtained. In a stock-pile of aggregate it is most likely to be found half-way up the pile and about a foot in from the surface. In a car it may be found at a point half-way between the center line and the side and midway between the middle and the end of the car, digging down a foot into the heart of the load. These are merely points shown by experience to be best, but fixed rules should never take precedence over judgment.

The larger pieces tend to work to the surface of a pile or load, which gives the aggregate the appearance of being coarser than it really is.

A water-bucketful of each aggregate, fine and coarse, is selected and taken to the testing place. The aggregate is poured onto a flat, smooth surface and then divided into quadrants with a trowel. Two opposite quadrants are thrown away. Part of the remainder is scooped into the 1/10 cu. ft. measure, the weight of which should be ascertained previously. The measure is filled in the same manner as a wheelbarrow is loaded on the job, without shaking or ramming, and care should be taken to arrive as nearly as possible at an accurate measureful. This is placed on the 24-lb. scale to determine the net weight in its wet, loose condition. This weight is multiplied by 10 to get the weight of a cubic foot.

Grading Procedure

A sufficient quantity of each aggregate should next be dried out for sieving. To determine the grading, 1,000 grams of the fine and 6¼ lbs. of the coarse, both thoroughly dry, will be found to be convenient amounts. The thousand grams of the fine aggregate are weighed out as accurately as possible and poured into the nest of sieves, care being taken to have them in proper order, with the larger sieves above. The sieves are vibrated with a peculiar rotary, rocking motion that is learned only by practice. Sifting should be continued for not less than 5 minutes or until not more than 1 per cent by weight of the sample passes any sieve during one minute. The collection of each sieve is poured out separately into the scale pan and its weight noted, which will be read and recorded as per cent. The first sieve that should contain any material is the No. 4. The contents of the next sieve is then added to the material already in the scale pan and the weight read and recorded as per cent and so on through the whole set. The total weight, together with the material on the pan, should equal 1,000 grams or 100 per cent. The finer sieves should not be scraped to remove pieces so tightly lodged that they cannot be jarred loose by tapping the sieve lightly.



Mixers must be equipped with devices for control of mixing water and time of mixing

The coarse aggregate should be handled on the larger scale—one reading to 20 or 24 lbs. by ounces. By using 6¼ lbs. of material, each ounce can be read as 1 per cent. If it is difficult to get 6¼ lbs. of material into the sieves without choking them, the sample should be split and sieved in two operations. The method of sieving and recording to be followed is the same as for fine aggregate.

The gradings—*Gf* and *Gc* in Form BD-1—are found by dividing by 100 the sum of the percentages found.

Use of Form BD-1

For entering the diagram at the bottom of the form the value of *Gc* already found, is reduced 0.1 for each 5 lbs. that the coarse aggregate (line *a*) is less than 100 lbs. per cu. ft.

The approximate value of *Gc* is located along the top curved line of the spider web curve, and is traced downward along the curve until it intersects the line indicating the strength of concrete desired. This intersection is marked (*X*) and a horizontal line is drawn through this point clear across the sheet. Where this line crosses the scale to the right, is read the number of pounds of combined aggregate required. This value is entered in line *b*. The value of *G*, required for entering in line *c* is located on the scale directly above the intersection (*X*). The proportions of fine and coarse aggregates are then found by the simple formula as indicated in line *d*. Note that the value of *Gc* used in the formula is the full value and not the reduced value which was used in entering the curves.

Field Mix by Volume

Multiplying the value of *b* by each of the values found for *d* as indicated in line *e*, gives the field mix by weight, which is required if the aggregates are measured in the field by weight. Dividing each of the values in line *e* by the respective weights of aggregates found in line *a* gives the field mix by volume.

Net Quantity of Mixing Water

To determine the net quantity of mixing water at the mixer, fine and coarse aggregates in the proportions determined in line *d* are weighed out in the scale pan, the total amount to be 1,000 grams. Alcohol is poured in the pan with the aggregates and ignited. As the alcohol burns off, the moisture is also driven off. It should be stirred occasionally with a steel rod, so that all parts are exposed to the heat of the flame, and so that there shall not remain any trace of moisture or alcohol. The difference in weight between the original 1,000 grams and that remaining is read off as per cent. One per cent is deducted for absorption and the result is entered in line *g*. Knowing this per cent, the net quantity of mixing water required at the mixer is found on the scale, applying to the strength of concrete being designed, in the diagram to the left of the spider web curve. The quantity required is found to be directly above (or below) the intersection of the line drawn through the point (*X*) and the per cent line. The simple calculations involved in lines *h* and *j* should give the same result.

Yield of Mixture

The yield is determined by reading the scale where it is intersected by the horizontal line previously drawn. No calculations are necessary. The extreme ease in determining the yield should recommend this form for the study of the economy of various aggregates.

Checking with Trial Batch

Having designed the mix, it is recommended that a check be made by making up a trial batch. The quantities necessary and their correct proportions are read off or easily calculated from the values on the scales designated "Trial Batch" where the horizontal line intersects these scales. The fine and coarse aggregates are each to be determined by multiplying the values indicated, by the values found in line *d* above. The quantity of cement is read off direct. The amount of water indicated on the scale is to be multiplied by the value found in line *j*. The values so found can be entered in their respective places just below the scales for ready reference in weighing or measuring out the materials. If a glass cylinder graduated to cubic centimeters is not available, it is recommended that the water be weighed out on the 1,000-gram scale. It is only necessary to remember that 1,000 c.c. of water weigh 1,000 grams.

Having first moistened the mixing pan, the fine and coarse aggregates are then weighed out and placed in the pan together with the cement and are mixed together. The water is then added and the mixture thoroughly mixed with the trowel.

Procedure for Slump Test

The mixture can be judged by its appearance as to texture, with trained judgment as a guide. The workability is measured by the slump method, which is as follows:

> The slump cone is moistened, placed on a level, non-absorbent surface and is filled about ⅓ of its height with the mix and is then tamped with 25 strokes of the tamping rod. The cone is then filled to about 4 in. of the top and again tamped. The cone is then filled to the top and again tamped. The tamping must not permit the rod to enter the concrete more than 3 in., but the tamping should be accomplished by vigorous strokes of the rod. The cone is then filled and struck level with the trowel, droppings removed from around the base, the cone removed with a gentle vertical pull and the slump measured. It should be somewhere between 1 and 3 inches if the design has been made as outlined. If not, the design should be checked over for possible errors. If, then, the desired slump is not obtained, an investigation should be made, as it is quite probable that there is some irregularity in the specific gravity or absorption factor of the aggregates and it is necessary to proceed with great caution. This matter of not being able to obtain the slump aimed at has led to some interesting discoveries, among them the detection of unsuitable aggregates.

Amount of Slump Desired

Because a concrete mixture with a slump of from 1 to 3 inches has been designed for, does not mean that this is the only one or the best to be used. It was chosen as being suitable for the majority of work which will be encountered, but may not be suitable for a certain kind of work. In thin walls or slabs or where heavy reinforcing material is encountered a slump of possibly 5 to 6 inches may prove to be more suitable. Where vibrators are used for placing, a slump of ½ to 1 inch will be all that will be required. In any case, adjustment can generally be made at the mixer and as indicated by notes at the bottom of the diagram in Form BD-1.

Moisture Content Determinations

After concrete operations get under way, frequent determinations of the moisture content of the aggregates should be made and adjustments made at the mixer. The simple and quick method outlined above recommends its frequent application. The slump cone should also be used as an index for the adjustments of volume of sand, which may vary because of bulking.

EDITORIAL

When Too Much Strength Is Dangerous

AT the recent annual meeting of the American Concrete Institute, timely warnings were sounded against the danger of over-emphasizing the strength of concrete and overlooking other factors such as density.

So far as outdoor concrete work is concerned, density and consequent watertightness are of far greater importance than strength.

Curiously enough, the tendency to work toward strength alone arises from the remarkable improvements in the quality of cement attained in recent years, and from the more widespread knowledge of strength control in making concrete.

Given a modern portland cement, engineers are regularly producing concrete of ordinary proportions with 28-day compressive strengths far in excess of the specification requirements.

The natural tendency, under such circumstances, is to reduce the cement factor, often to a point as low as four sacks to the cubic yard of concrete.

Such practice is positively dangerous when applied to concrete that is exposed to the full effect of weather conditions, to soil, or to running water. Unless concrete so exposed is made impervious to water, frost action and the leeching effect of water may disintegrate it.

One effective way to avoid trouble from this source is to establish a minimum cement factor for exposed concrete work. The correct factor in any given instance varies with the grading of the aggregates; but a minimum value of five sacks of cement to the cubic yard of concrete in place seems to have much to commend it for average materials.

Unless this or some equally effective precaution is taken, we are likely to experience another era of porous concrete in outdoor locations, with consequent disintegration.

Cultivating the Concrete-Encased Steel Building

THE 36-story office building now under construction for the Kansas City Power & Light Company provides a good illustration of the vast market for both monolithic concrete construction and for various concrete building units in structures that are not ordinarily rated as concrete buildings.

This building has a structural steel frame, but the steel is encased in concrete and the floors are of reinforced concrete joist-and-tile construction. What is more, the tile used in the floor construction is a light-weight concrete tile and the monolithic concrete is made with light aggregates.

Altogether, the superstructure of this steel building, so called because the structural frame is of that material, utilizes more than 11,000 cu. yd. of concrete and 150,000 concrete tile fillers.

Even in steel-framed buildings there is a great field for the contractor who specializes in concrete construction, for the producer of aggregates—light-weight aggregates more especially—and for the manufacturer of light-weight concrete back-up and partition units.

These three interests might well direct greater efforts toward the cultivation of this market.

Differences in Cements From Different Mills

MUCH has been heard in recent years about differences in the quality of portland cement made by different mills; hence, it is not surprising that some engineers and architects have become unduly concerned.

Differences in chemical composition do exist. There is also much difference in the degree of fineness and in the fineness distribution. Differences of this nature may affect such matters as time of set, early strength, and rate of hardening.

With these facts admitted, it is gratifying to know that unbiased tests show that there is nothing to worry about as regards the general run of concrete construction work, as in highways, bridges, buildings, and dams. Notable among such tests is the study of fourteen standard and four early-strength cements reported by Scholer and Koenitzer at the 1930 annual meeting of the A.S.T.M. That report, which was printed in condensed form in the August (1930) issue of "Concrete," should relieve the minds of engineers and architects.

It is only in special uses, involving severe service conditions, that variations in chemical composition, fineness of grinding, fineness distribution, and other matters of this kind, become important. Illustrations of such special uses are seen in concrete exposed to sea-water; in concrete exposed to sewage, as in municipal water-front structures, in monolithic concrete sewers, or in sewage disposal plants; in concrete tanks or vats for the storage of oil or chemicals; and in concrete exposed to alkaline waters.

With respect to these and similar special uses, the engineer should know more than he now knows about the cement he is specifying.

PROGRESS—In a Page

Current activities in research, in matters pertaining to concrete and cement, as being carried on or completed by various organized groups.

Study Concrete and Aggregates in A. S. T. M. Committee C-9

THE subcommittee of the American Society for Testing Materials Committee C-9 on Concrete and Concrete Aggregates reported considerable progress at the meeting of that committee held in Pittsburgh in conjunction with the group meeting of A.S.T.M. committees.

The *Subcommittee on Strength Tests of Concrete* conducted a survey of 56 testing laboratories to determine the advisability of raising the present temperature requirements for the storage of concrete and mortar specimens. The results of the survey indicated that present requirements should be retained. It was felt that a higher temperature would result in greater variations in temperature than a proper regulation of present requirements.

The *Subcommittee on Apparatus* presented a comprehensive report covering a study of the operation of pavement core drills. The report, which, it is expected will be published as a part of the annual report of the committee, discusses spindle speeds, spherical and crushed shot, thickness of bit wall, design of cutting end, hard and soft steel bits, pressure on drill spindle, addition of abrasives, such as sand, in addition to shot, diamond drills and other types of drills and abrasives.

The *Subcommittee on Measurement of Materials, Mixing and Placing of Concrete* presented two important reports, one covering the determination of materials in freshly mixed concrete and the other a method for determining the amount of materials in hardened concrete. It is expected that the latter method will be recommended to the society for publication as tentative.

The *Subcommittee on Specifications and Methods of Tests of Aggregates* reported on the requirements of quality and uniformity of fine aggregate and on a new method of test for determining the apparent specific gravity of coarse aggregate in the saturated condition. The committee is studying the effect of the rate of freezing on results obtained in the freezing and thawing tests. A study is also being made to determine the necessity of using pure sodium hydroxide in the performance of the color test for organic impurities.

The *Subcommittee on Curing* presented specifications for the curing of concrete and proposed them as tentative standards. The proposed specifications cover the following scope:

1. A general specification for curing, including cold weather curing.
2. Curing with wet coverings.
3. Curing with bituminous coverings.
4. Curing with surface application of calcium chloride.
5. Curing with calcium chloride admixture.

The *Subcommittee on Elasticity and Volume Changes of Concrete* was instrumental in having presented a paper on "The Effect of Aggregate and Other Variables on the Elastic Properties of Concrete," by P. M. Noble, which will be published as an appendix to the report of the committee.

The *Subcommittee on Ready-Mixed Concrete* has under way the preparation of a specification which it is hoped will form the basis of a purchase specification for ready-mixed concrete designed on the basis of (1) arbitrary proportions, (2) water-ratio method, (3) strength.

A. S. T. M. Tentative Specification for Concrete Masonry Units

DURING the spring group meeting of committees of the American Society for Testing Materials, held in Pittsburgh from March 16 to 20, inclusive, Committee C-10 on Hollow Masonry Building Units took the necessary action toward recommending the adoption of tentative standard specifications and tests for load-bearing concrete masonry units.

The proposed tentative specifications for hollow concrete units have been under consideration by the committee for about one year. During this time they have been under the review of the entire committee, which includes representatives from nearly all of the interests and sections of the country that are vitally concerned in such specifications.

The committee voted to form two new subcommittees, directing them to gather information on construction practices that affect the service qualities of masonry of hollow units. One of these subcommittees will deal with masonry of clay units and the other with masonry of concrete units.

A. S. T. M. Organizes Committee on Ready-Mixed Concrete

AT its last meeting in Pittsburgh, November 14, 1930, Committee C-9 on Concrete and Concrete Aggregates of the American Society for Testing Materials voted to form a new technical subcommittee to consider problems relating to ready-mixed concrete. R. B. Young, testing engineer for the Hydro-Electric Power Commission of Ontario, Canada, was appointed its chairman.

The increasing use of ready-mixed concrete during recent years has necessitated revision of general ideas concerning specifications for, and the mixing and handling of concrete. It is expected that an organization meeting of this subcommittee will be held shortly, at which the scope of its activities will be outlined. This committee, after careful and thorough study of the question, will then make its report to standing Committee C-9 for action.

Inspection Procedure

THE National Engineering Inspection Association, P. O. Box 1115, Pittsburgh, Pa., has issued the first edition of its Tentative Methods of Procedure for Inspection of Materials, a 30-page paper-covered booklet 5 by 7¾ inches in size.

One section of the booklet contains the Tentative Method of Procedure for Inspection of Cement, while another section covers the inspection of concrete work.

Estimating Quantities and Yield in Ready-Mixed Plant Operation

Yield and Required Quantities Must Be Definitely Known —Simple Methods of Computation Given and Explained —Illustrated by Examples

By **STANTON WALKER**
Director, Engineering and Research Division, National Sand and Gravel Association

ACCURATE methods for estimating quantities of materials for concrete are of particular interest to ready-mixed-concrete operators. The need for a dependable method is of even greater importance to him than to his contemporary, the contractor. Ready-mixed concrete may be furnished in relatively small lots, and cumulative errors may reach important amounts; the ready-mixed concrete operator does not have the same opportunities as the contractor to compare quantities of materials with the progress of the work and to make the necessary adjustments in proportions. Ready-mixed concrete is sold on a small margin of profit over actual cost of materials, mixing and hauling, and, therefore, accurate knowledge of cost is essential; the materials constitute a most important part of the cost of the finished product.

Several formulas have been proposed and a number of different tables have been computed to assist the engineer in estimating quantities of cement and aggregate for concrete. Certain of these tables and formulas give quite accurate results, while others lack accuracy or flexibility, or both, due to efforts to attain simplicity. Many such formulas and tables fail to take into account the part played by the mixing water, and, therefore, may be used only for rough estimates of average conditions.

Simple Method for Computing Quantities of Materials

This paper outlines a simple and easily-understood method for computing the quantities of materials required for a given volume of concrete or the volume of concrete produced by given quantities of materials. It discusses briefly methods for obtaining information necessary for making the computations. It shows comparisons between the results obtained by estimation and actual measurement, and gives examples of calculations for typical cases.

Basis of Method

The method described has for its basis the obvious fact that the volume of freshly mixed concrete is equal to the summation of the volumes occupied by the solid aggregate, solid cement, water, entrained air, and unfilled void spaces. It is applicable with equal accuracy to different types of aggregates. The method is neither new nor revolutionary; it has been described in literature and is based on sound, fundamental facts.

The volume of hardened concrete will, so far as practical considerations are concerned, be the same as that of freshly mixed concrete, except for loss of entrained air and mixing water. Properly proportioned concrete contains a negligible quantity of entrained air and unfilled void spaces; loss of water through the forms in sufficient amounts to affect the practical accuracy of the calculations will occur only from overwet mixes. Even in cases where entrained air is present in sufficient quantities to affect the apparent volume of concrete, the error will not be important when the volume of concrete in place is considered. Entrained air will be lost in transit and during the placing of the concrete in the forms, and, therefore, the volume of concrete in place will conform to the original estimates.

High Degree of Accuracy

Any error which may occur on account of loss of water tends to have something of a disciplinary effect on the operator; the volume of concrete in the forms would be less than estimated. Concrete should not be mixed wet enough so that this loss is an important amount; and, if it is, the operator deserves the penalty of the reduced volumes. Unfilled voids must not be permitted in concrete of good quality. These factors, therefore, are ignored in the method of calculation which is outlined. The method gives results accurate within 2 or 3 per cent so long as—

1. The concrete is plastic and workable, and all voids in the aggregate are filled with cement paste.
2. No water is lost, as in the case of extremely wet mixtures.
3. No important amount of air is entrapped, as in the case of very dry and lean mixtures and of mixtures of extremely fine aggregate.

Yield of Concrete

The determination of the volume of concrete produced by given quantities of materials consists, therefore, of the simple addition of the following factors:

1. Volume of mixing water (including surface moisture in aggregates).
2. Volume of solids in cement.
3. Volume of solids in fine aggregate.
4. Volume of solids in coarse aggregate.

Since the estimation of quantities for concrete consists of this simple addition and variations of it, it remains only to gain a clear understanding of what these factors are and how to obtain them.

Probably the simplest description of the volume of

Abstracted from paper read before the annual convention of the National Ready-Mixed Concrete Association, St. Louis, Mo., January 26, 1931.

solids is to say that it is the complement of the void content; if an aggregate contains thirty-five per cent of voids, then each cubic foot of it contains 0.65 of a cubic foot of solids. While this statement of solid volumes serves very well for the purpose of illustration, a more general statement will lead to a better and more flexible understanding of their use. It is that the volume of solids in a given amount of any material is equal to its weight divided by the weight of a unit volume of the solid material. The weight of a unit volume of solids is easiest determined by multiplying the weight of a unit volume of water by the specific gravity of the material. Specific gravity, as you all know, is the ratio of the weight of a given solid volume of the material in question to the weight of a like volume of water.

For example, water weighs 62.5 pounds per cubic foot, for average conditions of temperature; therefore, a substance with a specific gravity of 2.00 will have a weight of solids of 125 pounds per cubic foot.

Two Illustrative Examples

Let us consider a few examples of applying the method. Suppose it is desired to know the volume of concrete which will be produced by the following quantities:

Cement	564 lb.
Water (including surface moisture in aggregates)	35 gal.
Fine Aggregate	1,200 lb.
Coarse Aggregate	2,500 lb.

For the purpose of this example, assume that the specific gravities of the materials are the following:

Cement	3.1
Fine Aggregate	2.5
Coarse Aggregate	2.7

Then the weight per cubic foot of solids for each is,

Cement, 3.1 × 62.5 = 193.6 lb. per cubic foot.
Fine Aggregate, 2.5 × 62.5 = 156.2 lb. per cu. ft.
Coarse Aggregate, 2.7 × 62.5 = 168.6 lb. per cu. ft.

From this it follows that the solid volumes of material in the batch are,

Cement, $\frac{564}{193.6}$ = 2.91 cubic feet
Water, $\frac{35 \text{ gal.}}{7.5}$ = 4.67 cubic feet
Fine Aggregate, $\frac{1200}{156.2}$ = 7.68 cubic feet
Coarse Aggregate, $\frac{2500}{168.6}$ = 14.83 cubic feet

And the total volume of the batch of concrete is, 30.09 cubic feet of concrete

A second example illustrates how to determine the quantities of materials required for a cubic yard of 1:2:4 concrete, where the proportions are stated in terms of moist and loose volume.

DATA REQUIRED

Fine aggregate, weight per cu. ft. (moist and loose)	90 lb.
Fine aggregate, specific gravity (saturated-surface-dry)	2.6
Fine aggregate, surface moisture	5.0 per cent
Coarse aggregate, weight per cu. ft. (moist and loose)	100 lb.
Coarse aggregate, specific gravity (saturated-surface-dry)	2.7
Coarse aggregate, surface moisture	2.0 per cent

Quantity of mixing water added at mixer, 5 gal. per sack of cement.

CALCULATIONS

The quantities for a one-sack batch in terms of moist weights are:

Cement, 1 sack = 94 lb.
Fine aggregate, 2 cu. ft. = 180 lb.
Coarse aggregate, 4 cu. ft. = 400 lb.

Since the fine aggregate contains five per cent of moisture (based on the saturated-surface-dry weight), the weight of saturated-surface-dry fine aggregate is $\frac{180}{1.05}$ = 171.5 lb. Similarly, the weight of saturated-surface-dry coarse aggregate is $\frac{400}{1.02}$ = 392 lb.

From this it may be seen that the amount of fine aggregate used with one sack of cement contains 8.5 lb. of water and the coarse aggregate 8 lb. Therefore, the total quantity of mixing water, including the moisture in the aggregates is 5 gallons plus 8.5 lb. plus 8 lb., or,

$$41.65 + 8.5 + 8.0 = 58.15 \text{ lb.}$$

Then for the purposes of our calculations, the quantities for a one-sack batch may be expressed as follows in terms of saturated-surface-dry weights.

Cement	94 lb.
Fine aggregate	171.5 lb.
Coarse aggregate	392.0 lb.
Water	58.15 lb.

The weights per cu. ft. of solid volumes of the materials may be calculated as follows:

Cement, = 193.6 lb.
(See previous discussion.)
Fine aggregate, 62.5 × 2.6 = 162.5 lb.
Coarse aggregate, 62.5 × 2.7 = 168.6 lb.
Water, = 62.5 lb.

Therefore, the solid volumes in the above batch are:

Cement, $\frac{94}{193.6}$ = 0.485 cu. ft.
Fine aggregate, $\frac{171.5}{162.5}$ = 1.055 cu. ft.
Coarse aggregate, $\frac{392.0}{168.6}$ = 2.325 cu. ft.
Water, $\frac{58.15}{62.5}$ = 0.93 cu. ft.
Volume of one-sack batch = 4.795 cu. ft.

The number of batches required to produce 1 cu. yd. of concrete (27 cu. ft.) is $\frac{27}{4.795}$ = 5.63 one-sack batches. Therefore, the quantities per cu. yd. of concrete, in terms of saturated-surface-dry aggregates, are the following:

Cement, 5.63 × 94 lb. = 529 lb.
Fine aggregate, 5.63 × 171.5 lb. = 966 lb.
Coarse aggregate, 5.63 × 392.0 lb. = 2205 lb.
Water, 5.63 × 58.15 lb. = 327 lb.
Total = 4027 lb.

In terms of moist weights they are:

Cement, 5.63 × 94 lb. = 529 lb.
Fine aggregate, 5.63 × 180 lb. = 1014 lb.
Coarse aggregate, 5.63 × 400 lb. = 2250 lb.
Water, 5.63 × 5 gal. × 8.33 lb. = 234 lb.
Total = 4027 lb.

Twenty-Third Engineers Hold First Annual Meeting

The First National Reunion of the 23rd Engineers, the famous road construction regiment of the A. E. F. during the world war, was held at the Hotel Astor, New York, on March 19 and 20.

An inspection of New York harbor, luncheon on board the S. S. George Washington, on which the Twenty-third Engineers went to France, a theater party, military exhibit, company reunions and a banquet were included in the program.

This regiment of 4,880 men, next to the largest in the World War, was recruited by volunteer enlistment of technical and specially trained men secured through extensive advertising in the publications of the construction industries.

Repair Leak in Basement Wall of Museum of Natural History

Compound Mixed with Portland Cement and Sand Mortar Controls Setting Time—The Working Procedure

In the repair of a bad leak in the basement wall of the American Museum of Natural History in New York City in the summer of 1930, an interesting procedure was followed which is new in this country but is claimed to be accepted practice in England and other parts of the British Empire. Due to new construction adjoining this building, spring water was diverted from its former course to the foundation walls of the museum building. Under a considerable pressure head the water penetrated beneath the concrete basement floors, and, at one point at a low wall between two floor levels, it flowed in a steady spring-like stream through a section of porous concrete. The location of this leak is shown in Figure 1, from a photograph taken while the repair work was under way.

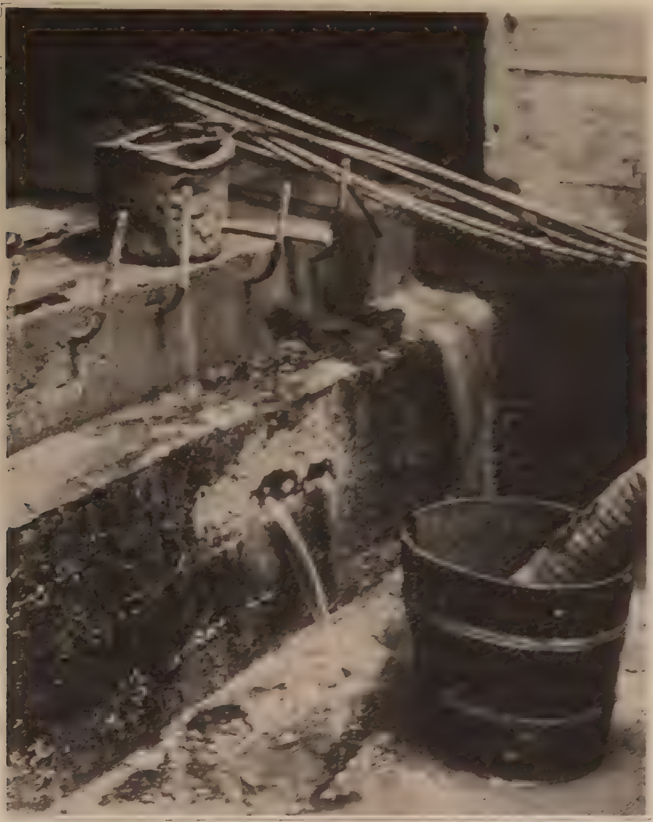


Figure 1. After damaged concrete was cut away the patch was coated with a cement-and-sand mortar containing a solution that caused initial set in 30 seconds

The Working Procedure

The procedure consisted in first chiseling away the porous concrete patch to a depth of about four inches. This patch was then plastered with a mortar of ordinary portland cement and sand, with which a solution had been mixed to cause the cement to take its initial set in about 30 seconds and its final set in from two to three minutes. Two small areas where the flow of water was stronger than elsewhere were left unplastered, with the intention of employing a more quick-setting combination in these smaller openings.

This stage of the repair work may be seen at the light-colored area in Figure 1, where jets of water are seen pouring through.

The third step in the repair work consisted in filling the two holes with a neat portland cement mortar with which the quicker setting solution was mixed. This brought about an initial set in 10 seconds and a final set in from 25 to 30 seconds.

The fourth and final step involved plastering the entire area of the repair work with a portland cement and sand mortar with which a normal setting waterproofing solution had been mixed. The completed work is illustrated in Figure 2.

This repair work, as described, was completed within half an hour after the old concrete had been chiseled away.

The Waterproofing Solution

The liquid waterproofing compound which activates the portland cement and controls the setting time, and which waterproofs the concrete, is a liquid solution mixed with the water used in mixing the concrete.

The solutions vary from one that is primarily a waterproofer and has no effect on the setting time of the cement to a solution that causes the cement to take its initial set in 10 seconds and final set in less than half an hour. Between these extremes there are three other solutions which set at certain times and which are employed in accordance with the requirements of each case in hand.

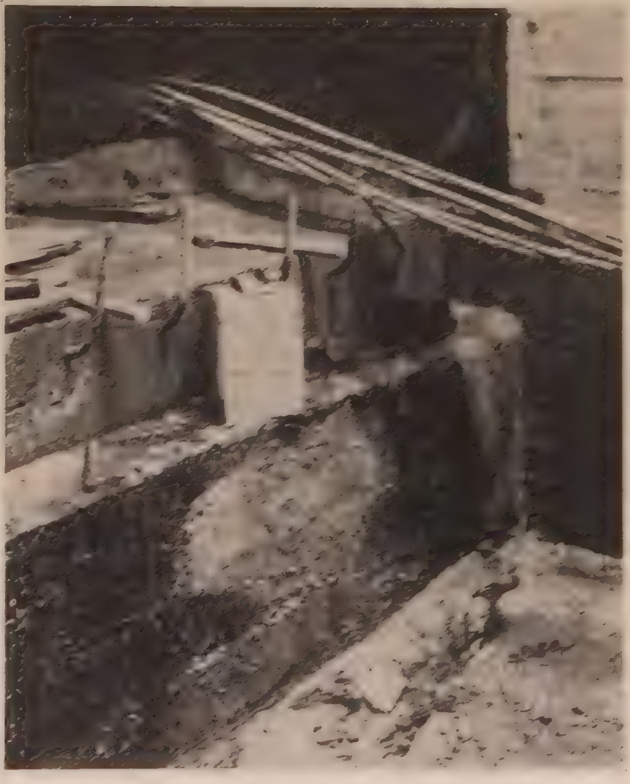


Figure 2. After filling holes shown in Figure 1, entire patch was plastered with mortar containing normal setting solution

Acknowledgment

The contractor was M. Shapiro & Son, of New York City. The compounds were furnished by the American Sika Corporation. New York City.

How Direct Mail Advertising Sells Concrete Products

One of Seven Advertising Tools Has Many Different Forms—Keeping Mailing Lists Up to Date—Avoid Cheapness in Preparation of Advertising Material

By R. MARSHALL
Advertising Counsel, Detroit, Mich.

ADVERTISING means making a thing public. To conduct a successful advertising effort in behalf, we'll say, of a line of concrete masonry units, the advertiser has a number of tools available. To mention seven principal tools, we have newspapers, local trade papers circulating among architects and builders, direct mail, billboards, car cards, signs on jobs, on your own delivery trucks, on your plant, and remembrance advertising such as match books, calendars, scratch pads and various novelties of paper, celluloid, leather and metal.

Direct mail will do a job for you that souvenir watch fobs can't pretend to accomplish. All these forms of advertising are so many available tools for you to use in making public the merits of your products. Use as many of these tools as is necessary to achieve your purpose.

Direct Mail Advertising

Among other factors you have to consider in conducting advertising by mail are these three, listed in the order of their importance:

(1) A list of prospects.
(2) Illustration.
(3) Copy.

You don't have to be told who your prospects are. Obviously the architects, the contractors, home owners who may contemplate alterations, the realtors, local manufacturing plants, public officials, public utility corporations and, in the smaller communities, farmers.

Making and Maintaining Mailing Lists

The name and address of each prospective customer should be neatly typed on a 3 by 5 filing card. All the pertinent information you can gather about the prospect should be placed on this card. For instance, if you make silo blocks, each farmer's card should carry information on the number of head of stock the farmer has, and details about the number and construction of his present buildings. All such information should be carefully checked. It should be kept up to date.

A little work every day will keep a good sized list in order and if you are not prepared to give such close attention to your mailing list, don't waste any money trying direct mail advertising. No use talking to a man who isn't there.

Use Only Good Illustrations

The second factor is *Illustration*. No matter what the physical form of your circular, make sure that the greater part of your story is told in picture. Get some good photographs of your plant, inside and outside. Don't try to make amateur photographs answer. Get a commercial photographer to do the job. Get pictures of the various concrete units you make for sale. Get pictures of important and interesting jobs on which your products are used. Be sure each is a good picture.

The Advertising Copy

And the third factor is *Copy*—your sales story in words. This story should be briefly, simply told. Make up your mind what you want your prospect to do and then ask him in simple English to do it. Above all, make him understand you will value his business. We all like to place our business with people who make it evident that they want it. In asking for business, you may have to give some reasons, and that brings us to the four things that every advertisement must do in order to help you to a sale.

1. The advertisement must create favorable attention. This may be done with the display heading, the illustration or the general layout or, as is more generally true, a combination of these. Remember the word "favorable" in this rule.

2. It must arouse interest. Your prospect has opened his mail and has your message in his hands. His favorable attention has been attracted. Immediately his interest must be aroused or he tosses your mailing piece aside and your effort has failed. Picture and words must be cunningly used to arouse and hold his interest.

3. With his interest aroused, your mailing piece should create desire in the mind of the reader. It should paint so alluring a picture of your goods or your services that your prospect will want them.

4. Finally, there must be something in your circular to impel action. If the reader's desire for your stuff has been created, there must be a powerful closing phrase, an enclosed reply card, an invitation to visit your plant, an urge for him to call you on the telephone—something that will impel your prospect to do something about it.

The Letter Form of Advertising

The letter, after all is said and done, remains one of the simplest and most effective ways of telling your sales story by mail.

Have a good letterhead designed. Make it tell something about your business. You can give it selling force without any sacrifice of dignity. Print it in two colors. Costs more, worth more. Use good paper. Use a good

---

Condensed from address before joint annual meeting of Concrete Masonry Association and Wisconsin Concrete Products Association, Milwaukee, Wis., February 24, 1931.

envelope. A good envelope is like a clean suit of clothes on a salesman—it helps create that all-important first impression. Use your trade mark or a picture of a concrete unit on your envelope. Print it in two colors.

Make your letter long enough to tell what you have to say—no shorter, no longer. Don't waste words in a letter that will be repeated in the enclosure. Sign the letter in ink or provide for a facsimile signature.

The Circular

A second form of mailing piece is the circular. The circular should be well illustrated. Don't use words to tell what a picture will tell better and quicker. Use color printing but use it intelligently. Remember that your mailing piece is competing for the reader's attention with a lot of fine advertising literature issued by cement companies, radio manufacturers, Bedford limestone, iceless refrigerators, motors, and so on.

Combination Letter and Circular

A third form is a combination of the two just referred to— a letter and a circular all on one piece of paper. This is generally termed an illustrated letter. Most generally it consists of four pages, each of standard letter size. Page one may be your regular letterhead, on which you will write a sales letter. Pages two and three are the circular part—illustrations and type matter. Page four may be used for additional illustrations or to accommodate that portion of your letter which won't go on page one.

One good feature for an illustrated letter is a page of line drawings, made to scale, illustrating the various sizes and shapes of units you regularly carry in stock.

As to cost, a four-page illustrated letter can be produced and mailed for from 5 to 7 cents. That includes everything — art work, engravings, printing, multigraphing, filling in, addressing, enclosing, and the postage.

The Photo Post Card

The photo post card is a fourth mailing form, humble it is true, but resultful if properly used. One side of the card is an actual photograph, perhaps of your yard or some of your units or a job where they were used. Half of the address side is available for a brief printed sales message.

Blotters That Blot

No discussion of direct mail advertising is complete without a few words on blotters. Everyone uses blotters. If you could get all your prospects using your blotters your name and your business would be constantly before them. Blotters, properly used, represent good, sane advertising effort.

But be sure they'll blot. Don't get these slippery, shiny, enameled blotters that take printing fine but won't soak up ink. The mission of a blotter is to drink ink. If it's a teetotaller it's an economic failure. Your blotter will be welcomed only if it will do a good blotting job. Your sales message is incidental. A monthly mailing of a good, thick, spongey, thirsty blotter will do you a lot of good. Don't attempt to say much on it. Printing the calendar for the current month on it is a good idea. That and a few words about what you have to sell.

The House Organ

Then there's the house organ. A house organ is a periodical issued by a manufacturer to keep his trade in touch with his progress. It may be a magazine of many pages or it may be a little four-page leaflet. I have a suspicion the little four-page kind will be read most. To ring the bell, it must be interesting. Its items should be brief and informative.

Combined Blotter-House Organ

Strange as it may seem, you can combine the blotter form and the house organ form into one piece. It isn't at all impossible to issue a good white blotter once a month, printing on one side of it interesting items designed to increase the sale of your products. Typographically, it should be arranged as a newspaper page of two narrow columns. It should have a name and be dated and have an editor. You can pack a lot of selling wallop into twelve issues of a blotter house organ. The expense is moderate.

Testimonial Letters

Finally, we have the good old testimonial letter. They make excellent enclosures. If the letter is from the architect who designed the building, the contractor who built it or the owner who bought it, a picture of the completed building should be added to the circular.

A Continuous Campaign

Now these are a few of the forms of direct mail advertising. A campaign might be conducted using any one of these forms. A better campaign might be built using several of them. Whatever is used, it should be used continuously. There should be no stop to your direct mail advertising—it should be sent out constantly, month after month, year after year. Don't overlook your present customers. It's just as important to keep a customer you already have as it is to get a new one. Keep your friends sold on you and your business.

Carbon Concrete Brick Company Promotes Winter Work

Of interest to concrete products manufacturers in northern sections of the country is the effort of the Carbon Concrete Brick Company, Youngstown, Ohio, to promote cold weather construction. That this company believes in winter work is evidenced by a news article, quoting its sales manager, James P. Davis, published in *The Youngstown Daily Vindicator.*

Mr. Davis points out that it is more advantageous to build during cold weather than in summer, simply because more efficient building equipment and more highly skilled workmen are available during winter months. In addition, he indicates that architects are also able to give winter builders the best of it because in that season their draftsmen are not rushed with work. As a result, they are able to give undivided attention to plans ordered in the winter.

Mr. Davis mentions further that all companies furnishing materials for winter construction do so from a stockpile accumulated for this purpose during the summer months. All concrete units delivered by his own company are taken from their large warehouse, where a stock of 100,000 concrete building blocks is carried at all times.

Precast Reinforced Concrete Units Used in Crib Construction in California

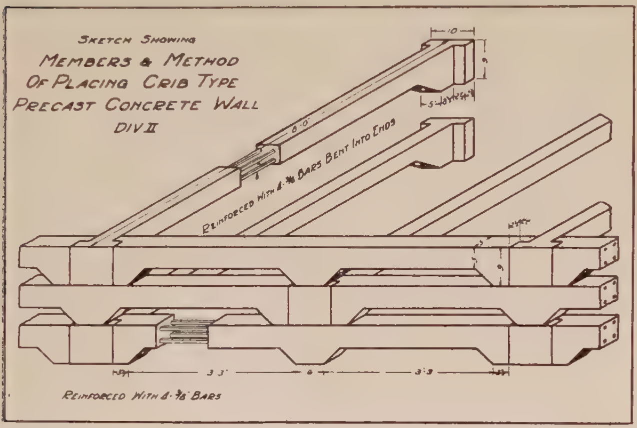
California State Highway Commission engineers have evolved a concrete crib construction on the Pacific highway near Weed, Siskiyou County, which has decided advantages over a masonry wall or other form of construction, at least, for the conditions surrounding this particular job.

The crib construction is composed of precast reinforced concrete members which interlock one with the other to form a stable structure. The alternating layers of headers and stretchers are each made up of members five inches square and eight feet long, with necessary lugs for interlocking cast at either end.

Retaining Wall

This particular wall is 165 feet long, and varies in height from 4½ to 7 feet. It serves to retain the roadway slope at a point where the location is on a hillside immediately above the Southern Pacific Railway.

Crib type of construction was chosen because of the difficulty in securing a safe foundation with the usual type of masonry or concrete wall, and for the additional reason that ample drainage at this point must be assured.



Due to its lighter weight and flexibility this type of wall has many advantages. It can be placed on foundation material that would not support a gravity wall. Water from it drains out freely, so there is no danger of undermining.

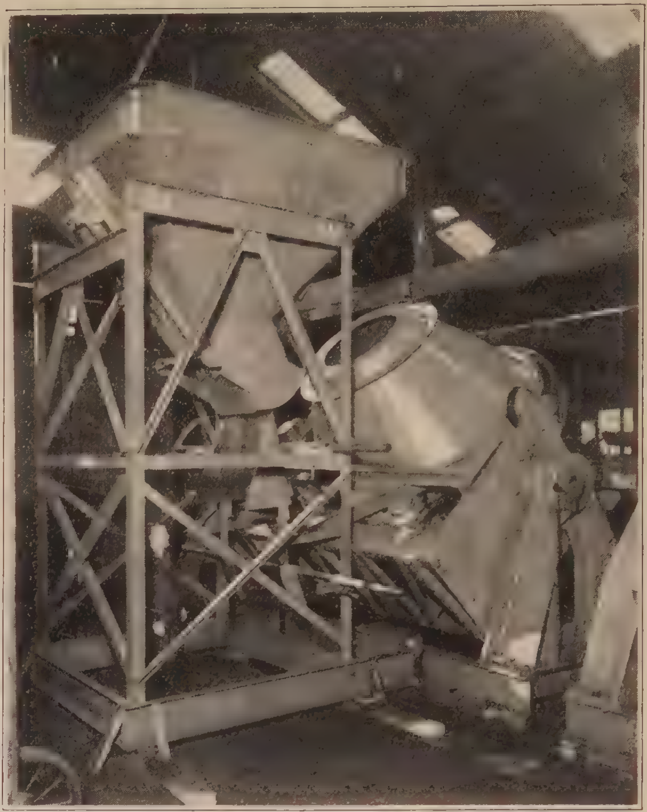
Eighteen cubic yards of concrete were used in casting the members of the wall. The total cost, including backfill, was $1179.45, as compared with an estimated cost of $1700 for a rubble masonry retaining wall. All the work on the crib wall can be done by common labor.

Mixes Eight Tons of Concrete in One Batch

The first of two giant concrete mixers, built in San Francisco for use in the construction of Owyhee Dam, Oregon, has recently been completed. With its capacity of eight tons of concrete per batch, it is believed to be the largest stationary mixer in operation.

The mixing drum, by itself, is ten feet in diameter and thirteen feet long. Complete, the mixer measures twenty-seven feet in length, nineteen feet in height and about fifteen feet in width. It weighs 33 tons and handles four cubic yards of concrete in a single batch.

In spite of its huge bulk, the mixer is easily controlled by one man by means of pneumatic controls. An important feature of the machine is its automatic weighing and proportioning of sand, stone, cement and water. And if the aggregates are wet as they come to the mixer, adjustment is automatically made in the amount of water used.



It is estimated that nearly 60 40-ton railway cars will be needed every day to keep the mixer working and supplied with fresh materials.

Tearing Up Chicago Street

The accompanying illustration shows the tearing up of an 8-in. concrete street at Grant Park, Chicago.

The concrete once broken, a grab hook is substituted for the skull-cracker and the concrete blocks are pulled aside to be hauled away.

Where More Research Is Needed in Concrete Highway Work

Eleven Problems Named as Most Important—Co-ordinated Effort Needed by Groups of States Having Similar Construction Problems—Stating Facts in Simple Form

This is the first of six or eight articles, each complete in itself, which will deal with various phases of highway engineering and construction methods and practices and with related activities in the field of research.

These articles are based on detailed letters and discussions received from highway officials of twenty-six states, in response to inquiries addressed to them by "Concrete."

In view of the nation-wide scope of this survey, the information to be presented will represent a genuine cross-section of present-day views and practices.—The Editors.

WHAT type of research is most helpful to highway engineers, and in what directions are further investigations most needed?

The foregoing question, addressed by CONCRETE to engineering officials of state highway departments, has drawn replies from representative highway engineers from all sections of the country. These replies indicate that more information is needed on a number of problems that now perplex the men who are responsible for highway construction. The frequent mention of certain ones among those problems suggests the following approximate order of importance, the most important being named first:

(1) Studies of subgrade soils, drainage and frost action, and their relation to concrete pavements.

(2) Design of concrete mixtures with special reference to simplicity of procedure.

(3) Factors affecting durability of concrete.

(4) Design of pavement slabs and sections, and studies of slab action.

(5) Comparative efficiency of improved methods of curing.

(6) Traffic surveys.

(7) Concrete materials for highway pavements.

(8) Use of coarser sizes of aggregates in concrete mixtures.

(9) Construction methods.

(10) Causes and prevention of cracking.

(11) Studies of cement.

More Important Phases Needing Research

It is only proper to add that considerably more stress was placed on the first six of the above items than on the remaining ones, and that practically all replies emphasized the importance of subgrade soils. Notable among the comments on the importance of some of the problems needing further study is that coming from William J. Titus, Chief Engineer, Indiana State Highway Commission. "Research regarding subgrade soils, design of pavement section, type and combination of materials, and traffic surveys," he writes, "are all of great value to the highway engineer. To select any one as the most important is probably not possible, since to build adequate roads economically, all of these features must be studied, and conclusions can be drawn only from adequate data."

Limit to Research by Individual States

As several writers point out, the highway departments of individual states can not, except in rare exceptions, conduct exhaustive research programs, since they are expected to expend their funds for direct construction and maintenance. This point was well stated by T. H. Cutler, Chief Engineer, Missouri State Highway Department.

"Because state highway departments are usually rather limited in the amount and character of research that can be undertaken," says Mr. Cutler, "some satisfactory method of co-ordinated or centralized research would seem desirable between a group of states in which construction problems are similar. Specific problems could be attacked with greater efficiency by a properly trained research organization, and more reliable and helpful information could be developed, than by the disjointed efforts of separate state organizations. Effective research is being accomplished by the National Research Council, the U. S. Bureau of Public Roads, the A. A. S. H. O., and others; but in spite of these agencies, highway engineers are continually confronted with the selection of new devices and materials that might be intelligently incorporated into their designs and construction work."

Similar views were expressed by Gibb Gilchrist, State Highway Engineer, Texas State Highway Department. "Research work of a radical nature," he declares, "can not be done on state highways, where the public is waiting to use the finished product. Research that calls for only slight changes can be conducted on our state projects. Because such state investigations and experiments are made under actual traffic conditions, they are very valuable. For instance, it is often possible to find a method of decreasing costs by some slight change in control. We are conducting this class of research in this department."

Research Findings Must Be Stated Clearly

Several engineers emphasized the need for having the facts developed by research interpreted into language that is readily understood and put into service by simple methods. In this connection a typical expression came from R. B. Gage, Chemical Engineer, New Jersey State Highway Commission, who wrote: "Any method of research that will convince the inspectors and the various engineers that they should make a serious effort to acquaint themselves with the specifications and compel the use of materials as specified, will certainly result in a marked improvement in the quality of concrete pavements being constructed."

The solution to the point raised by Mr. Gage may perhaps be found in a comment by W. L. Lesher, Materials Engineer, Idaho Department of Public Works, to the effect that "the type of research most helpful to highway engineers is that research which is brought down to the basis where it can be readily used in the field and understood by the inspectors who are required to enforce the new methods. Any research should be brought to this basis before it is released for general use."

In a word, the uncovering of facts has little more than academic value unless such facts are supplemented by specific instructions for their practical application.

Question of Subgrades Most Neglected

W. C. Buetow, State Highway Engineer, Wisconsin Highway Commission, expresses the belief that considerable study must be given, in the near future, to subgrades. "The all-important consideration of a highway," he asserts, "is the stability of the subgrade, and at the present time the highway engineer knows little about the subgrade. While some study has been given to this subject, more intensive research should be inaugurated."

The foregoing opinion is supported by C. M. Ziegler, Construction Engineer, Michigan Highway Department, who writes that his department considers research work on soils as affecting road drainage and frost action a matter of the greatest importance.

The design of concrete mixtures is another subject mentioned in many letters as a matter of outstanding importance. C. M. Hathaway, Engineer of Construction, Illinois Division of Highways, names the design of concrete mixtures by the mortar void method as one of the two outstanding research problems now under investigation by his department. The Texas State Highway Department has been successful in introducing the mortar void method, and has effected an appreciable reduction in the cost of concrete pavements by its use.

Several of the engineers who emphasized the importance of the design of concrete mixtures were just as emphatic in stating the need for more simplified procedure and for more accurate and less complicated control equipment.

Others of the eleven research problems listed earlier in this article were discussed in considerable detail. It will suffice, however, to repeat what several of the writers said, namely, that the facts developed by research must be passed all the way along to the job inspectors and the paving foremen if those facts are to be utilized to the fullest extent.

A. S. T. M. Regional Meetings Draw Large Attendance

Nearly three hundred members and guests of the American Society for Testing Materials located in the New York metropolitan district attended a district meeting of that society on the evening of March 5, at the Hotel New Yorker. A paper of exceptional interest was presented by A. E. Lindau, of Chicago, under the title of "Limitations of Our Present Knowledge of Concrete Construction," an abstract of which is soon to be published in CONCRETE.

The regional meeting in Pittsburgh, held at the William Penn Hotel, March 16 to 20, inclusive, took the form of a spring group meeting of A.S.T.M. committees, and was attended by about five hundred members.

Twenty-three committees held sessions during the entire 5-day meeting period. Committee reports of special interest to the concrete construction industry were presented by Committee C-9 on Concrete and Concrete Aggregates and by Committee C-10 on Hollow Masonry Building Units. Both of these reports are discussed on page 26 of this issue of CONCRETE.

Coming Conventions

April 15-17—American Society of Civil Engineers, spring meeting. Norfolk, Virginia.

April 21-24—Building Officials' Conference of America, seventeenth annual meeting. Toronto, Ontario, Canada.

April 27-30—National Terrazzo and Mosaic Association, annual convention. Biltmore Hotel, Atlanta, Georgia.

May 12-16—National Fire Protection Association, annual meeting. Toronto, Ontario, Canada.

May 20-21—National Concrete Burial Vault Association, annual meeting. Neil House, Columbus, Ohio.

June 3-4—National Lime Association, thirteenth annual convention. White Sulphur Springs, West Virginia.

June 22-26 — American Society for Testing Materials, annual meeting. Stevens Hotel, Chicago, Illinois.

Joint Committee Develops Features of New Report on Concrete

Distinguish Between Outdoor Concrete and Concrete in Protected Locations—Watertightness Most Important Element of Durability

The Joint Committee on Specifications for Concrete and Reinforced Concrete met in the rooms of the Western Society of Engineers, Chicago, on February 27 and 28. This committee, which is made up of five representatives each of the American Society of Civil Engineers, American Society for Testing Materials, American Railway Engineering Association, Portland Cement Association, and the American Concrete Institute, is a reorganization of the committee that made reports on concrete specifications in 1921 and 1924.

A number of developments since the 1924 report makes certain changes in the specification desirable. Among the advances which have been made, relating to concrete as a material in recent years, the most significant are the developments in cement, use of ready-mixed concrete, and a more widespread understanding of the design of mixtures, with increasing attention to field control.

In the field of design, an outstanding development which should be covered in future reports of the committee is the tendency toward the greater use of rigid frame construction.

All these developments are to be given consideration by the reorganized committee, in addition to a general study of the 1924 report with a view to improving its presentation and widening its scope.

Specifications and Recommended Practice

The committee proposes in its report to separate portions which are in the nature of specifications and those which are in the nature of recommended practice. It is planned also to add as an appendix the technical data upon which the recommendations of the report are based.

The committee is considering the necessity of distinguishing between the requirements for so-called outdoor concrete and concrete in locations such as heated buildings not exposed to the effect of weather. Watertightness as an element of durability will be recognized as one of the essentials of concrete for outdoor exposure. The necessity for this has been brought about by the recent development of generally higher strengths in portland cements. Following the practice which has become quite general of designing concrete for a given strength requirement, it is possible with these newer cements that mixtures will result which are too lean for proper durability. Some limitation will, therefore, be placed upon the cement content to avoid this difficulty.

In the field of design of reinforced concrete, the committee proposes to present the recommendations in regard to moment coefficients by putting primary emphasis on the general case of unequal spans, thus reversing the arrangement in the 1924 report, in which the emphasis is placed on a series of equal spans. Moment coefficients will be given only for the case of equal spans and these will be presented with separate coefficients for live and dead load.

The next meeting of the committee has been set for June 22 and 23, in Chicago.

Concrete Masonry Association Papers

This issue of "CONCRETE" contains two of the valuable papers presented to the joint annual meeting of the Concrete Masonry Association and the Wisconsin Concrete Products Association recently held in Milwaukee.

Other papers from that unusual program will appear in each issue for the next few months.

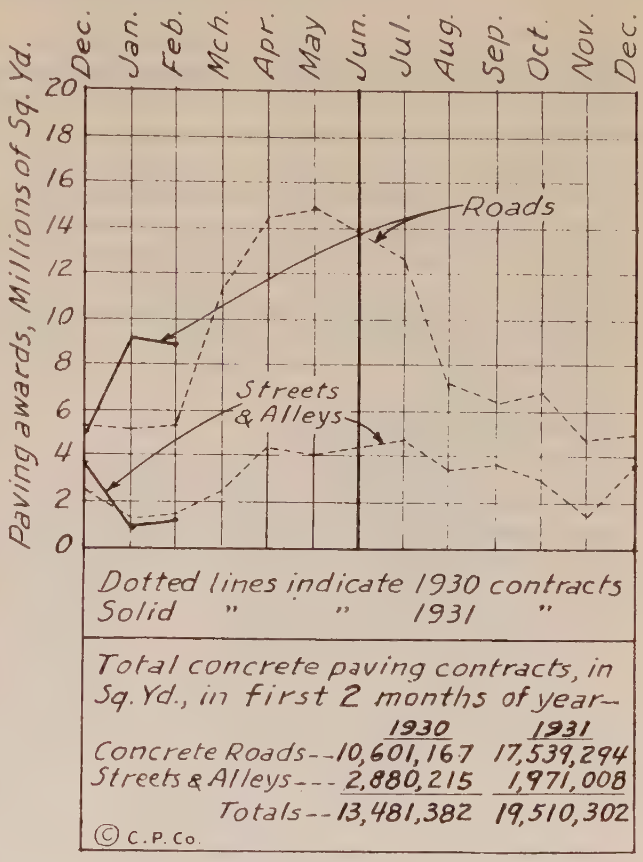
This will answer inquiries from a number of readers as to whether those papers will be made available through the pages of "CONCRETE."

Concrete Highway Awards Continue in Heavy Volume

Street Paving Contracts Only Fair—Total Paving Far Ahead of Last Year

Contracts awarded in February for the construction of concrete highways continued in heavy volume, according to reports received by the Portland Cement Association.

The totals for February amounted to 8,321,025 sq. yd. of concrete roads, and 1,081,800 sq. yd. of streets and alleys, compared with 5,356,904 sq. yd. of roads and 1,529,901 sq. yd. of streets and alleys in February, 1930. Totals for the first two months of 1930 and 1931 are shown in the drawing.



Dotted lines indicate 1930 contracts
Solid " " 1931 "

Total concrete paving contracts, in Sq. Yd., in first 2 months of year—

	1930	1931
Concrete Roads	10,601,167	17,539,294
Streets & Alleys	2,880,215	1,971,008
Totals	13,481,382	19,510,302

© C. P. Co.

To be reproduced only by permission

Residential Building Makes Turn for Better

A turn for the better has been made by residential building, according to figures on contracts awarded in February and reported by the F. W. Dodge Corporation.

With total contracts for residential building construction amounting to $77,917,800 in February, in the 37 states east of the Rocky Mountains, an improvement over the corresponding month of the year before is seen in this class of occupancy for the first time since 1928.

General Construction Contracts

Total general construction contracts reported by the Dodge organization in 37 states amounted to $235,405,100 in February, compared with $317,053,000 in February, 1930. The total for the first two months of this year is $463,361,500, compared with $641,028,200 a year ago.

Short-Cuts in Structural Design

Time-Saving Chart Aids in Computing Soil Pressures Under Foundation Walls of Buildings, Chimney Footings, Bridge Piers and Similar Cases

II—Intensity of Pressure Under Footings

By **JAMES R. GRIFFITH**
Professor of Structural Engineering, Oregon State Agricultural College

A FEW readers will recall having seen this chart before. So before telling what it is and what it does, it may be well to tell how it came into existence. I shall present the evidence and let the reader be the judge.

During 1924 I had the pleasure of working on some of the unique problems in connection with the electrification of the Chicago terminal of the Illinois Central Railroad. My squad boss was John H. Blair. The design of the catenary structures and signal bridges came under the jurisdiction of the distribution engineer, J. S. Thorp. This was one unit in the department of W. M. Vandersluis, electrical engineer.

How the Chart Originated

Several of our foundation problems were of a type different from that usually encountered. Thorp had us get out a pamphlet, in blueprint form, showing the solution of some of the problems. He thought it might help someone on future electrification projects. The pamphlet was called "Foundations."

One problem shown was the solution of spread pole foundations resisting overturning moments in two directions. Thorp had unearthed a similar problem on bridge piers by Frederick Karl Esling in the Proceedings of the Institution of Civil Engineers (England), Vol. CIXV, session 1905-1906. Esling had boiled his contribution down to a table requiring two-way interpolation. I always did abhor interpolation, even of the one-way variety, and this table was "impossible." So one day I began plotting the values in the table as I would plot stadia shots for a contour map. I then interpolated for even values, connected like values, and got a chart resembling a contour map of a hill. Upon later investigation I found that Esling had plotted similar curves in order to get his tabular values. The chart, herein presented, gave a much quicker solution than the table Esling used.

This chart appeared, in abbreviated form, as Figure 5 in a paper presented by Thorp at the summer convention of the A. I. E. E. at Detroit in June, 1927.

Credit Belongs to Esling

Imagine, then, my surprise in seeing the same chart presented in great detail in the June, 1927, issue of another Chicago engineering and contracting publication, but credited to an employe of the Illinois Central not connected with the electrical engineering department.

I have hesitated to say anything publicly on this matter till now. But this chart fitted into the scheme of the present series, and I did not want the readers of CONCRETE to think it had been copied without giving due credit. Credit for the original idea should go to Esling.

Use of Chart

In order to use this chart it is first necessary to reduce all overturning moments to the plane of the base, parallel with the major axes (b) and (d). Its use will be demonstrated by determining the maximum pressure under the base of a gravity smoke stack, Figure 1.

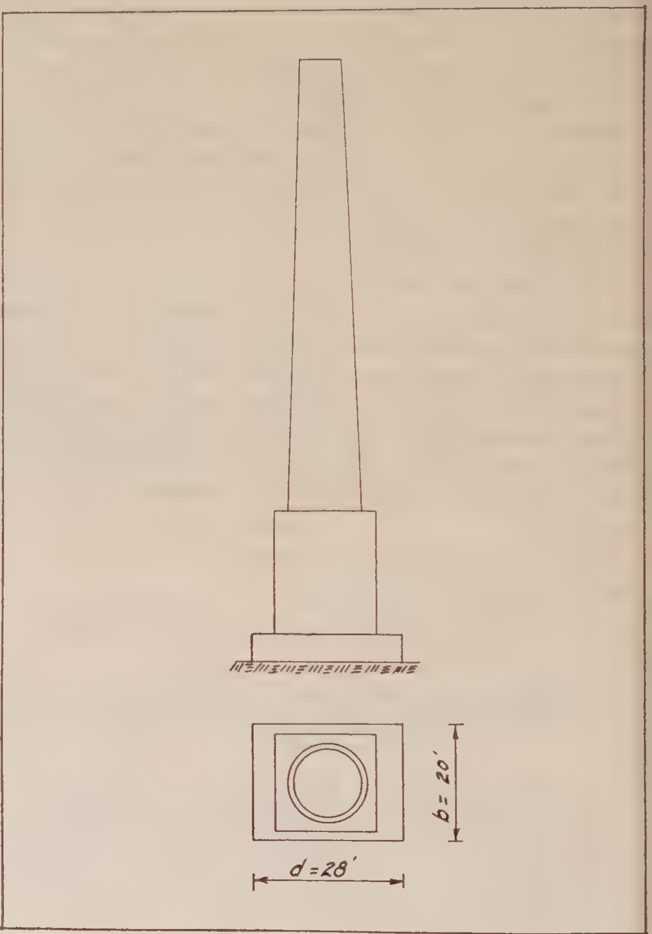


Figure 1

Assume that building conditions prohibited the extension of the base in one direction, thereby necessitating a rectangular base, $b = 20$ feet, $d = 28$ feet. Weight of stack, including foundation, $W = 1{,}693{,}000$ lb. Overturning moment above base, due to wind $= 2{,}720{,}000$ ft.-lb.

Wind parallel to side, $d = 28$ feet.
$M_d = 2{,}720{,}000$ ft.-lb.
$M_b = 0$.
$W = 1{,}693{,}000$ lb.

$$K_d = \frac{M_d}{W\,d} = \frac{2{,}720{,}000}{1{,}693{,}000 \times 28} = 0.0573$$

Going to the chart I find at a value of $K_d = 0.0573$, a contour value $K_R = 1.35$.

Maximum pressure $= \dfrac{W}{b\,d} K_R = \dfrac{1{,}693{,}000}{20 \times 28} \times 1.35 =$ 4,080 lb. per sq. ft.

Wind parallel to side $b = 20$ feet.

$M_d = 0$
$M_b = 2{,}720{,}000$ ft.-lb.
$W = 1{,}693{,}000$ lb.

$$K_b = \frac{M_b}{W\,b} = \frac{2{,}720{,}000}{1{,}693{,}000 \times 20} = 0.0803$$

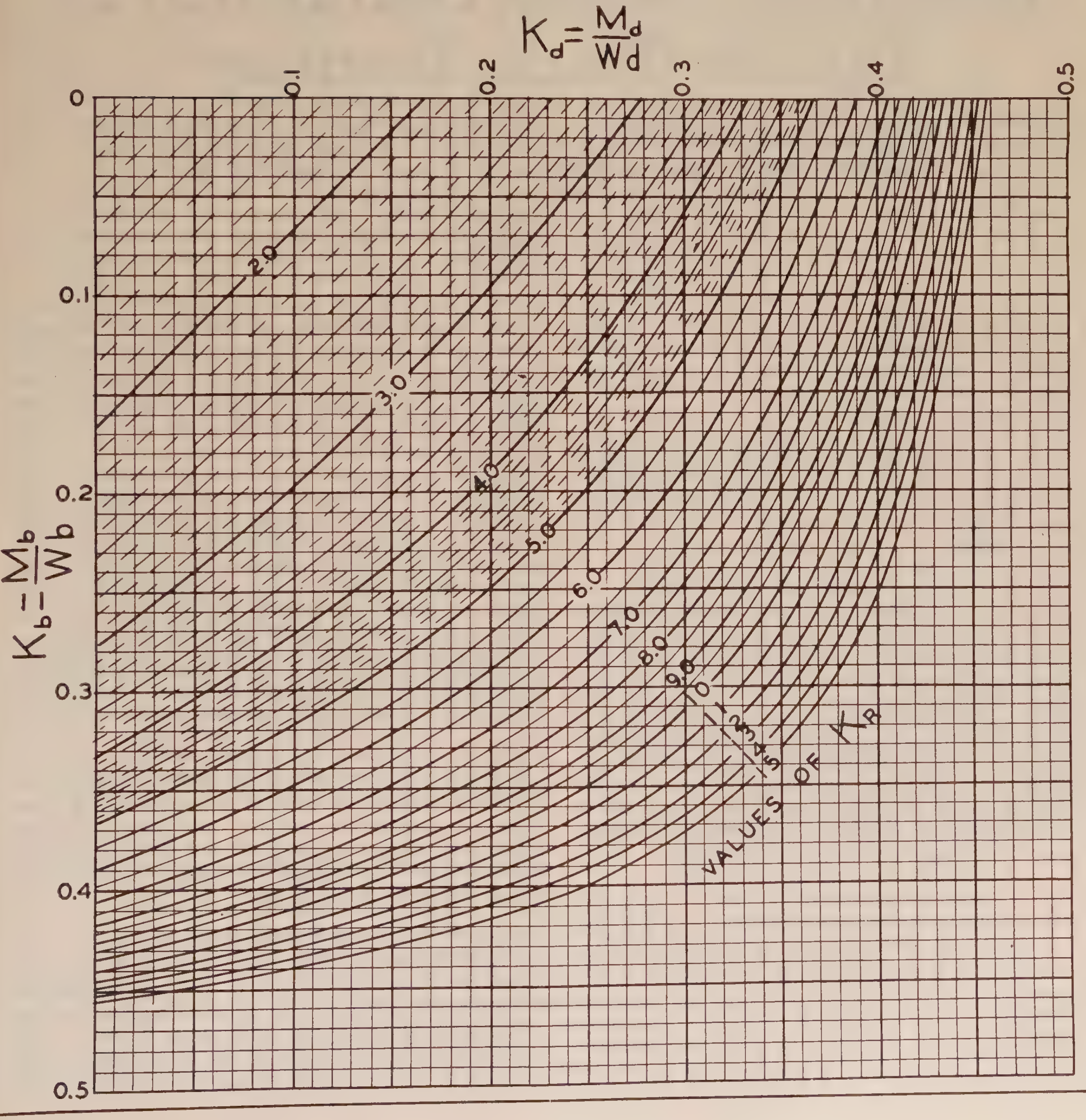
On the chart at a value of $K_b = 0.0803$, I find a value of $K_R = 1.48$.

Maximum pressure under base $= \dfrac{W}{b\,d} K_R$

$$= \frac{1{,}693{,}000}{20 \times 28} \times 1.48 = 4{,}475 \text{ lb. per sq. in.}$$

Intensity of Pressure Under Footings

Maximum pressure $= \dfrac{W}{b\,d} K_R$



Wind parallel to diagonal.

Reducing moment into components parallel with sides,

$M_b = 1{,}580{,}000$ ft.-lb.

$M_d = 2{,}210{,}000$ ft.-lb.

$$K_b = \frac{M_b}{W\,b} = \frac{1{,}580{,}000}{1{,}693{,}000 \times 20} = 0.0467$$

$$K_d = \frac{M_d}{W\,d} = \frac{2{,}210{,}000}{1{,}693{,}000 \times 28} = 0.0467$$

On the chart, at the intersection of these values of K_b and K_d, I find a contour value of $K_R = 1.53$.

$$\text{Maximum pressure} = \frac{W}{b\,d}\,K_R = \frac{1{,}693{,}000}{20 \times 28} \times 1.53 =$$

4,630 lb. per sq. ft.

Chart Has Many Uses

Two of the examples given show the solution when the moment is parallel with one axis. This illustrates that the principle is applicable to a one-way as well as a two-way moment. Esling applied the method to the design of bridge piers. I have used it for pole foundations, gravity stacks, foundation walls of buildings and many other cases.

When the resultant falls inside the kern of a rectangular base, the solution by slide rule is about as easy. When the resultant falls outside the kern, and moments are in two directions, the chart is a real labor saver. Such was the case with our pole foundations for the Illinois Central.

Developing Dealer Distribution in Outside Trade Territory

Omaha Plant Ships Concrete Units from 35 to 150 Miles —Getting the Outside Business—Value of Trade Mark—Out-of-Town Dealers Protected

By A. V. JOHNSON
Vice-President, Ideal Cement Stone Co., Omaha, Nebr.

IN a discussion of dealer distribution there are two sets of dealers to consider. First, there are the dealers in the home town and local market; second, the dealers outside of the manufacturer's local market.

This discussion is concerned mainly with the latter group. However, since dealer distribution in the local market has received consideration by some manufacturers and is operative in certain cities, it might be well to set forth some of the salient features which argue for and against this plan.

Points Favoring Local Dealer Distribution

Some of the arguments advanced in favor of local dealer selling instead of direct selling in the local market are that the manufacturer can operate his business with a smaller personnel, confine his efforts entirely to manufacturing; and instead of carrying numerous accounts with contractors and builders, he need have only one or a few accounts on his books, and these with dealers who discount their bills early the following month. Selling and credit departments are thus made unnecessary in the manufacturer's organization. Capital requirements for carrying accounts receivable are reduced to the minimum.

Where Local Dealer Distribution Fails

If the traffic could bear the cost, the mason supply dealer could sell more block than the manufacturer could with his own organization. His desire to do so would, however, be governed by the amount of profit that accrued to him through their sale, as compared with the profit offered him by the sale of clay tile, brick or gypsum block. And just at this point, we discover a weak link in this chain, and one of the most effective arguments against dealer selling for the local market—the dealer may become the price dictator.

To say that this plan saves the block manufacturer all selling expense and credit losses is, of course, not the truth, because he must pay these items to the dealer in the form of commissions or discounts. The dealer, in addition, adds also a net profit on the business he does. This plan of distribution for the local market will for this reason usually necessitate higher selling prices.

In a community where there are numerous block plants, and especially if some of the block manufacturers are also mason supply dealers, it is certainly better for the manufacturer to sell his own product.

Reaching Out Over Wider Trade Area

The second group of dealers comprises those located outside of the purely local trade area of the block plant. We do not here have in mind direct selling to builders and contractors served by long distance trucking, 15 to 30 miles. We are thinking of territory from 35 to 150 miles away, reached by rail shipments.

Conditions in Omaha Trade Territory

Our own trade territory includes eastern Nebraska, western Iowa and northern Missouri. Here are numerous small towns located in agricultural territory on the ten railroads leading out of Omaha in every direction. Most of these towns have only one or two lumber dealers, who are also the mason supply dealers, and furnish nearly

---

Condensed from paper read before the joint annual meeting of the Concrete Masonry Association and the Wisconsin Concrete Products Association, Milwaukee, Wis., February 24, 1931.

everything in the way of building material used in the community.

We have been trying for 18 years to interest these dealers in selling our concrete blocks to their trade, but we have only scratched the surface of the potential market that exists in this territory.

Getting the Business Away from Home

How can the manufacturer make a start in seeking this dealer business away from home? It is all very simple. First, get a good map showing the territory in which you are interested. Make a list of the towns you think you can reach. Obtain from the railroads the freight rates per hundred pounds from your shipping point to the various destinations. Find out if these rates are the same as apply on competitive materials. If unfavorable to block, take steps to remove the discrimination. Then figure out how much this freight amounts to, per block.

Next decide on your base prices, the selling price per block on board cars at your plant. By adding the freight per block to the base selling price, you arrive at the delivered price. There are some other things to consider, though, before delivered prices are established. Perhaps you might be willing to take a lower base price in order to equalize the higher freight on one or more long hauls to particularly attractive markets.

Dealer Lists and Credit Ratings

The Lumbermen's Red Book, R. G. Dun & Co. and Bradstreet's reference books give these dealers' names, and also the credit information needed before making shipments.

We have tried numerous ways to interest the dealers in selling our product. We have made many personal calls, although it does not pay to have a man traveling the territory continuously. In our opinion it pays to send direct mail, letters or blotters at regular intervals, and make personal missionary calls at frequent periods. We have also sent mail matter to prospect lists furnished us by the dealers, calling attention to our product and to the dealer as our distributor.

Trade Mark an Essential Aid

We learned very early in our experience that it is essential to have and to advertise a trade mark for the ready identification of one's product. We were spending some money for dealer helps, trying to interest owners and contractors in our blocks, telling them about their good qualities, and who and where the dealers were who could supply them. Without a trade mark, how would the users know they were getting the advertised block? So we adopted a trade mark, a small, inconspicuous star-shaped impression, had it registered in the government patent office at Washington, and started to advertise "Star" concrete blocks.

Handling Carload Shipments

If you have a weight agreement instead of having each carload shipment track-scaled, considerable delay is saved in transit, and the freight charges can be accurately determined without waiting for a return of the freight bill. It saves errors and disputes which may arise because of mistakes in track-scale weights. Our agreement with the Western Weighing and Inspection Bureau enables us to advise the customer of the exact amount of freight charges that he should pay the railroad company and deduct from his remittance. The customer always pays the freight and sends the bill back to us for credit.

Protecting Out-of-Town Dealers

We try to protect out-of-town dealers against direct buying by the contractors and farmers in their community. Sometimes we both lose out in pursuing this policy, but one must adopt some certain policy and stick to it. You can't sell the retail trade and the dealer, too, unless you agree to protect the dealer with a commission on certain sales which are best handled direct by the block manufacturer.

Annual Proceedings and Abstracts of American Concrete Institute

The American Concrete Institute continues to issue on special order annual volumes of *Proceedings*, similar to the volumes published before publication of a monthly *Journal* began in November, 1929, except that the new volumes contain the *Abstracts*.

The *Proceedings* for any one year will comprise that part of each monthly *Journal* (September to June, inclusive) containing papers, committee reports and discussions of them, with page numbers consecutive through the volume. The *Journal* is not published in July and August.

The *Abstracts* of current literature on cement and concrete, also published in the monthly *Journal* and given consecutive page numbers, will be bound with the *Proceedings*.

For $2.10 per volume, a reader may, through the Institute, have his own *Proceedings* and *Abstracts* sections of the *Journal* bound uniform with previous years, an advantage not always possible when the work is given to local binders.

Members wishing to retain their monthly *Journals* separately instead of binding them can obtain a bound volume (in addition to the monthly *Journals*) by ordering them in advance of the issuance of the September *Journal* each year, at a special member price of $3.00. The Institute will accept standing orders (from members only) for the 1932 and subsequent volumes at this additional charge of $3.00. The regular member price for a bound volume when not ordered in advance is $6.00.

CONSTRUCTION METHODS AND COSTS

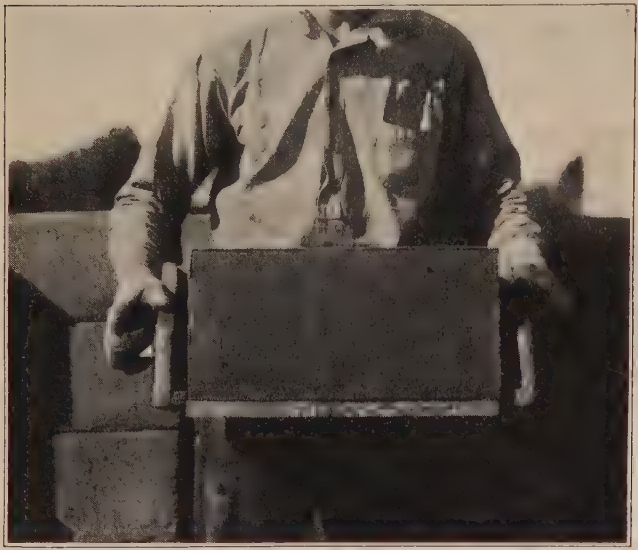
Starting in the May issue a construction superintendent, in a series of three articles, will describe the construction of two units of a large power generating plant.

The construction methods described include caisson construction, shoring and sheet piling, and methods of mixing, handling and placing the concrete work.

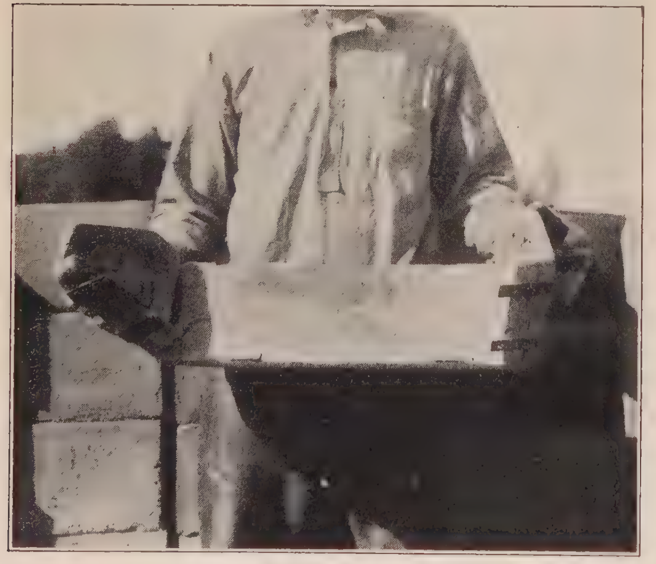
The final article of the series will contain cost data having very definite value to contractors and estimators.

Device Aids Carrying of Freshly Made Block

For a number of years the D. H. Merritt Building Material Company of Lincoln, Nebraska, has used a simple and thoroughly satisfactory home-made device for carrying fresh concrete block from the machines. This device, in two positions, is shown in the accompanying photographs. Briefly it consists of three pieces of one-inch material cut from a board eight inches wide. The back side is made approximately two inches longer than the block pallet. To each end of this back board is hinged another piece for the ends about as wide as the pallet and with the front corners cut off as shown. A 1-by-1 in. cleat is nailed flush to the bottom half of each of these end pieces, and three strap irons, bent to form right angles, are drilled and screwed in place over the lower outside edges so that their lower ends project ½ in. past each cleat. These strap irons fit under the ends of the pallet to support it when the block is to be moved.



Here the block is being transported to the yard



This shows the device with ends spread after the block has been delivered

A wooden cleat cut from a block of 2-by-4-in. material, is then nailed to each hinged end, and the lower side cut away in such fashion as to insure a handy positive grip of the workman's fingers.

When the machine has been broken to expose the fresh block this device is slipped in place and the workman then merely carries the block to its temporary curing place within the yards.

There is no danger of damaging edges or otherwise mutilating good blocks, and it has speeded up the moving of these fresh blocks considerably.

Unskilled Workman Builds Concrete Block Manhole

One of the talking points in favor of concrete masonry units is that they can be laid satisfactorily by intelligent workmen who are not masons by trade.

The concrete block manhole illustrated is an excellent proof of the truth of this claim. The manhole is part of a large sewer contract recently built for the city of Dearborn, Michigan, by the General Contracting Co., of Detroit.

Concrete block manhole laid by an unskilled workman, in Dearborn, Mich., for the city. Contractor was the General Contracting Co., of Detroit

When the time was at hand for building this manhole the mason who had built the previous one could not be located. An unskilled workman who had never before built a manhole of any kind of material volunteered to do the work. He was given the chance, and he produced good results.

The workman explained afterward that whenever the chance was offered he had watched the mason laying up these concrete block manholes and that he was eager to try his hand at it.

Quality of Concrete Masonry Units Set by State of Wisconsin

State Industrial Commission Issues List of Approved Units—Code Provisions and Test Methods Given—Clay Tile Regulated in Same Manner

THE physical requirements for concrete masonry building units and hollow clay tile intended for use in building construction work in Wisconsin are included as part of a 24-page pamphlet issued by the Industrial Commission of Wisconsin. The pamphlet contains a list of manufacturers of concrete units and hollow clay tile whose products have been approved (effective January 1, 1931) for use in load-bearing and exposed construction.[1] The list includes 62 concrete products manufacturing plants throughout the state of Wisconsin, one in Minnesota and one in Illinois. Of the 62 Wisconsin plants, 24 are located in Milwaukee.

Test Procedure and Code Requirements

The method of selecting, marking and shipping test specimens, and instructions for making tests are given in the last three pages of the pamphlet. Extracts from the building code issued by the Industrial Commission are included also. The building code requirements, in so far as they relate to concrete masonry building units, or to concrete units and hollow clay tile alike, are given in the following.

Concrete Block Used in Bearing and Exterior Walls.—(a) Strength. All concrete blocks used in exterior or bearing walls shall have a compressive strength of not less than 700 pounds per square inch gross area as laid in the wall.

The average strength of any group of test specimens of concrete block shall be not less than the above requirements. The strength of individual test specimens shall not vary more than 5 per cent below the above requirements. These compressive strength values shall be developed in a proper atmosphere and in a curing period of not more than 28 days from the date of manufacture.

(b) Absorption of Moisture and Durability. Concrete block used in walls directly exposed to the weather shall absorb moisture in the immersion test not to exceed 12 per cent of the dry weight of the specimen, except that where the net weight of a concrete block is less than 140 pounds per cubic foot the absorption of moisture in per cent of dry weight shall not exceed the quotient of 12 times 140 divided by the net weight of the concrete block in pounds per cubic foot.

(c) Branding. All concrete blocks used in exterior or bearing walls shall be branded with a distinctive indentation or waterproof stencilled mark, and shall bear the name, initials or trade-mark of the manufacturer.

(d) Tests. Typical specimens of all sizes and designs of concrete block used in exterior or bearing walls shall be tested in an approved manner, originally to prove compliance with the requirements of this code, and thereafter at intervals of not more than one year. Further tests may be demanded at any time there is reasonable suspicion of non-conformance to the requirements of this code.

Use of Clay Tile and Concrete Blocks in Bearing and Exterior Walls.—Approved clay tile and concrete blocks may be used in bearing and exterior walls of buildings not more than 3 stories, or 45 feet in height, or in panel walls in buildings of any height.

Concentrated loads shall be transmitted to clay tile or concrete block masonry by plain concrete, reinforced concrete, or solid masonry.

Where clay tile or concrete blocks are used in party walls, there shall be not less than two such units used in making up the thickness of the wall unless solid masonry is used for building all chases, recesses, framing of all openings, and for the support, anchorage and protection of all joists and beams carried into such wall.

Where a single unit of masonry does not constitute the full thickness of the wall, the bonding of units shall be by masonry only. Where a brick facing, or backing, is used, the bond shall consist of a full header course of brick every sixth course of brick, or equivalent. Where the facing or backing is also of clay tile, or concrete block, the bond courses shall be placed at intervals of not more than 16 inches.

Clay tile and concrete blocks used in bearing walls shall be well bedded in mortar. The net bearing area of all clay tile and concrete blocks as laid in the wall shall be such that the allowable unit stress on the mortar is not exceeded.

All clay tile laid with cells vertical shall be laid in portland cement or natural cement mortar. All clay tile laid with cells horizontal and all concrete blocks shall be laid in cement-lime, or better, mortar.

Concrete Block Used in Non-Bearing Partitions.—All concrete blocks used in non-bearing partitions shall comply with the requirements for use in bearing and exterior walls, or shall be branded with a distinctive impression to identify them for use only in non-bearing partitions.

Clay Tile and Concrete Blocks Used in Floor Construction.—(a) General Requirements. Where hollow clay tile or concrete blocks are used in concrete floor construction in a way that the whole or any portion of a tile or block is subjected to a load, the requirements which apply to tile or block used in exterior and bearing construction shall be complied with.

Where hollow clay tile or concrete blocks are used in concrete floor construction in a way that no portion of a

Note: A list of concrete blocks and clay tile which have been approved, also specifications describing the approved manner of making tests, may be obtained from the Industrial Commission.

---

[1] See also page 26 of February (1931) issue of CONCRETE.

tile is subjected to a load, the requirements which apply to tile used in partitions shall be complied with.

(b) Branding. All clay tile or concrete blocks used in floor construction shall bear the name, initials or trademark of the manufacturer.

Subscribe to Concrete Masonry Research Program

Contributions in liberal quantities and amounts have been forthcoming for the support of the research program of the Concrete Masonry Association, inaugurated by the research committee of that organization.

Following is a list of 127 companies and individuals who made contributions prior to March 6:

Birmingham Slag Company, Birmingham, Ala.
Cement Products, Inc., Phoenix, Arizona.
Hamden Building Tile Company, Inc., Hamden, Conn.
Washington Concrete Products Corp., Washington, D. C.
Gifford-Wood Company, Aurora, Ill.
J. F. Apfield, Bloomington, Ill.
Chicago Haydite Building Units, Inc., Blue Island, Ill.
Nelson Concrete Culvert Company, Champaign, Ill.
Illinois Slag and Ballast Company, Chicago, Ill.
Van Houten Brothers, Chicago, Ill.
W. G. Traver Supply Co., Decatur, Ill.
Martin Thorsen, DeKalb, Ill.
Verslius Building Supplies, East Moline, Ill.
Elmhurst Chicago Stone Company, Elmhurst, Ill.
Chicago Insulcrete Company, Franklin Park, Ill.
Hilker Supply Company, Granite City, Ill.
Ideal Concrete Company, Inc., Joliet, Ill.
Welsch Waterproof Block Company, Joliet, Ill.
A. H. Einfeldt, Moline, Ill.
Ideal Concrete Block Manufacturing Company, Peoria, Ill.
Peoria Concrete Construction Company, Peoria, Ill.
Holm-Page Block, Sand & Gravel Company, Rockford, Ill.
Rockford Cement Products Company, Rockford, Ill.
Camden Cement Tile Company, Camden, Ind.
Concrete Products Corporation, South Bend, Ind.
Cinder Block & Material Company, Cedar Rapids, Ia.
Hydraulic Company, Council Bluffs, Ia.
The Cement Products Company, Davenport, Ia.
Iowa Concrete Crib & Silo Company, Des Moines, Ia.
Cement Products Company, Estherville, Ia.
Whelan Concrete Products Company, Topeka, Kans.
Maine Concrete Company, Brunswick, Me.
Cinder Block Corporation, Baltimore, Md.
Nelson Concrete Stone Company, Baltimore, Md.
Elkton Concrete Products Company, Elkton, Md.
Cinder Concrete Units Corporation, Boston, Mass.
Fall River Cast Stone Company, Fall River, Mass.
Concrete Products Company, Falmouth, Mass.
Lite-Crete Products Company, Inc., Medford, Mass.
Massachusetts Cement Block Company, Medford, Mass.
Forsberg Cement Block Company, Worcester, Mass.
B. A. Crandall, Benton Harbor, Mich.
Standard Building Products Company, Detroit, Mich.
Universal Cinder Products Company, Escanaba, Mich.
Van E. Dailey, Howell, Mich.
Wilbee Concrete Products Company, Jackson, Mich.
Casper Haas, Kalamazoo, Mich.
Markle Cement & Coal Company, Muskegon, Mich.
C. A. Wilcox, Royal Oak, Mich.
H. A. Boyer Company, Faribault, Minn.
A. P. Swanson, Hibbing, Minn.
Cast Stone Block Factory, Lanesboro, Minn.
Volz Art Stone Company, Clayton, Mo.
Kansas City Duntile Company, Kansas City, Mo.
The Funck Company, St. Louis, Mo.
St. Louis Duntile Company, St. Louis, Mo.
St. Louis Concrete Products Mfg. Company, Webster Grove, Mo.
D. H. Merritt & Sons, Lincoln, Nebr.
Reimer's-Kaufman Company, Lincoln, Nebr.
Harding's Fuel & Supply Company, Omaha, Nebr.
Ideal Cement Stone Company, Omaha, Nebr.
Lyman-Richey Sand & Gravel Company, Omaha, Nebr.
Omaha Concrete Stone Company, Omaha, Nebr.
Geo. D. Shellberg, Omaha, Nebr.
Fred D. Shields Company, Inc., Omaha, Nebr.
Frank Whipperman, Omaha, Nebr.
Bergen Building Block Company, Ridgefield Park, New Jersey.
Albany Gravel Company, Inc., Albany, New York.
Capital District Concrete Products Association, Albany, N. Y.
Ramloc Stone Company, Inc., Albany, New York.
Bedford Hills Concrete Prod. Co., Bedford Hills, N. Y.
Straub Building Units, Inc., Binghamton, N. Y.
Waterside Concrete Works, Bronx, N. Y.
John H. Black Company, Buffalo, New York.
Geneva Brick Products Company, Inc., Geneva, N. Y.
Jamestown Block & Tile Company, Jamestown, N. Y.
Ray Perrigo, Malone, N. Y.
Mastic Cement Block Works, Mastic, L. I., New York.
Concrete Building Supply Company, Plattsburg, N. Y.
Genesee Brick & Supply Corporation, Rochester, N. Y.
Southampton Cement & Supply Company, Inc., Southampton, N. Y.
Nepperhan Concrete Products Corporation, Yonkers, N. Y.
Concrete Specialties Company, Camden, N. J.
W. B. Shoe, Spencer, N. C.
Williams Lumber Company, Wilson, N. C.
Twin City Tile Company, Winston-Salem, N. C.
Carthage Concrete Block Works, Cincinnati, O.
The Dayton Brick Company, Dayton, O.
Excel Concrete Block Company, Mt. Healthy, O.
Crew Builders Supply Company, Norwood, O.
The Oakley Concrete Block Company, Cincinnati, O.
Citizens Builders Supply Company, Toledo, O.
National Cement Block & Supply Company, Toledo, O.
Straub Patented Block Company, Warren, O.
Hollywood Building Block Company, Allentown, Pa.
Bradford Building Block Company, Inc., Bradford, Pa.
Messinger Supply Company, Easton, Pa.
Erie Patent Block Company, Inc., Erie, Pa.
Shellito Block Company, Grove City, Pa.
Harrisburg Building Block Company, Harrisburg, Pa.
Johnstown Cinder Block Company, Johnstown, Pa.
Lancaster Concrete Tile Company, Lancaster, Pa.
Morse Cement Tile Company, Northeast, Pa.
Penn Building Block Company, Philadelphia, Pa.
General Cement Products Company, Pittsburgh, Pa.
Berks Building Block Company, Reading, Pa.
Newton D. Benson, Providence, R. I.
Builders Concrete Stone Company, Pawtucket, R. I.
Stone-Tile Supply Company, Memphis, Tenn.
Columbus Concrete Products Company, Columbus, Tex.
Penniman Concrete & Material Company, Dallas, Tex.
Fort Worth Concrete Tile Company, Inc., Fort Worth, Tex.
San Angelo Building Material Company, San Angelo, Tex.
Turner Gravel Company, San Antonio, Tex.
Lester Lumber Company, Martinsville, Va.
Grays Harbor Cement Products Company, Aberdeen, Wash.
Port Angeles Concrete Products Company, Port Angeles, Wash.
Concrete Masonry Units Company, Tacoma, Wash.
Yakima Cement Products Company, Yakima, Wash.
Kanawha Cement Block Company, Charleston, W. Va.
Beloit Concrete Stone Company, Beloit, Wis.
Ideal Concrete Products & Fuel Company, Beloit, Wis.
Martin Winger & Son, Hazelhurst, Wis.
The Ira Beyer Concrete Products, Mishicot, Wis.
Julius Sorenson & Sons, Racine, Wis.
Wausau Concrete Company, Wausau, Wis.
Economy Concrete Products Company, Wauwatosa, Wis.

How to Estimate Concrete Work

Beginning in the near future, "CONCRETE" will publish a short series of articles containing detailed cost estimates of all structural features of a reinforced concrete building.

The estimating of concrete form work will be included.

The author of these articles is a well known construction engineer who has had extensive experience with several large construction companies.

Gaining First Cost Economies in Concrete Highway Bridges

Reduce Cost by Reducing Cubic Yardage of Concrete—Design of Bridge as Monolithic Elastic Frame Seen as Best Solution—Higher Working Stresses Will Help

By C. B. McCULLOUGH
Bridge Engineer, Oregon State Highway Department

Here is the second abstract from a paper read by Mr. McCullough before the December meeting of the Highway Research Board in Washington, the previous abstract having appeared on pages 45 and 46 of the March issue of CONCRETE.

The complete paper, containing a number of diagrams and explanations pertaining to the use of the monolithic elastic frame in concrete bridge design, is soon to be published in the Proceedings of the Highway Research Board under the title of "Cost Economies in Concrete Bridges."—The Editors.

THE first cost of a concrete bridge is the product of cubic yardage and unit cost, and the problem of cost reduction is that of reducing one or both of these factors. Unit yardage costs may be reduced to a slight extent by a careful study of the design from the standpoint of the form carpenter, to the end that the maximum degree of simplicity in form construction, consistent with quality and architectural excellence, may be produced. Unit yardage costs may also be reduced by a curtailment of some of the present-day specification requirements, but only at a distinct sacrifice in quality and at the expense of additional maintenance later on.

Reduction in Yardage of Concrete

It would therefore appear that any material first cost reduction must accrue through the employment of designs requiring less yardage, and that the problem should be approached from this latter direction rather than from the standpoint of unit costs.

There are but few methods of approach to this latter problem. The cubic yardage in any concrete bridge may be reduced by a reduction in live-load carrying capacity, but with present-day traffic this is obviously not the solution. Highway bridges are in general designed for a traffic loading considerably less than the maximum individual load which is likely to cross the structure. In nearly every state in the Union there are construction units employing steam shovels or other heavy equipment whose gross weight runs from thirty to forty tons and even higher, and these heavy load units, during the course of line revision or widening projects, are moved up and down the highways in such a way as to render their passage over one or more bridge structures imperative in many instances. It is not true economy to design for these occasional and extraordinary loads, but their presence and the increasing frequency of their occurrence certainly dictate against the reduction of present standard loading requirements.

A yardage reduction may be effected through a reduction in present roadway widths or through the use of higher unit working stresses. Certainly the former expedient is not sound policy in view of the trend of present traffic development. The use of higher unit working stresses appears to offer possibilities. Perhaps we are not getting enough out of our materials. The concrete of today is most assuredly an entirely different product from that of a few years ago. The introduction of scientific methods of design for concrete mixes, the improvement in methods of field control and manipulation of materials, inundation of aggregates, the employment of field equipment for the accurate proportioning of ingredients by weight,—these and many other developments have operated to produce a field material denser, more uniform, and much more dependable. Should we not take advantage of these conditions in the design of our concrete sections by employing higher working stresses with a consequent reduction in yardage? In certain cases and to a certain extent this may be done. Yet this is a procedure that must be approached with extreme caution. An undue trend in this direction will unquestionably result in simply taking a certain sum from our construction funds and placing it back again in our maintenance budgets. Several of the national engineering associations have committees at work on this particular problem at the present time, for which reason any conclusion as regards the extent to which first cost economy may be effected through the employment of higher unit working stresses is perhaps somewhat premature. Certainly some economy is possible; how much is an open question.

It would appear that we have just about exhausted the field of inquiry and that as yet we have arrived at no very definite solution. We have indicated certain features in design practice and field control of materials and workmanship which will operate to reduce maintenance costs.[1] We have shown the need for careful location study in order to prolong service life and decrease amortization costs. In the field of first cost reduction we have just now pointed to the possibility of economies as the result of a fuller utilization of the material (higher unit working stresses), but have drawn no definite conclusion.

---

[1] See March (1931) issue of CONCRETE, pages 45-46.

Utilizing the Elastic Frame

There appears to be one expedient, however, which has not been considered—one which has escaped the attention of many American bridge engineers until recent years. This expedient is the fuller utilization of the elastic properties of the structural frame. This is a rather high-sounding phrase, but when shorn of its technical significance it means that the structural parts of the entire bridge or other structure are considered and designed as a monolithic, elastic frame.

In other words, by adopting a monolithic elastic frame as the structural load-resisting part of the bridge the entire structure is put to work. This is what is meant by the phrase "the fuller utilization of the elastic properties of the structural frame."

The monolithic frame, viewed in accordance with this concept, is nothing more nor less than an elastic reservoir whose purpose is that of absorbing an amount of resilient energy sufficient to balance the corresponding loss in load potential energy as the structure deflects under load. This resilient energy is yielded up to restore the structure to its normal position as the loads are removed.

The monolithic elastic frame not only effects a distinct saving in the cubic yardage of concrete, but it has the further advantage of widening the field for architectural expression.

Hoover Dam Contract Awarded to Combination of Firms

Contract for the construction of the Hoover dam, on which bids were opened on March 4, has been awarded to the low bidders, Six Companies, Inc., of San Francisco, at their bid price of $48,890,995.

Other bids included one of $53,893,878, submitted by the Arundel Corporation, of Baltimore, and another, totaling $58,653,107, submitted by Woods Brothers Corporation, of Lincoln, Nebr.

Six Companies, Inc., is a combination of six western construction companies who have pooled their resources and equipment for the purpose of building this great project. The six companies which entered this combination include the Utah Construction Company, Henry J. Kaiser and W. A. Bechtel & Company, McDonald & Kahn, Ltd., Morris Knudsen & Company, J. F. Shea Company, and the Pacific Bridge Company. William H. Wattis, of Ogden, Utah, president of the Utah Construction Company, is head of Six Companies, Inc.

The contractors are allowed 1,965 days to complete the dam within 300 feet of the top. At this point it will be possible to begin the generation of electrical energy. All the work specified in the contract held by Six Companies, Inc., must be completed in 2,565 days, or by the summer of 1938.

The dam, when completed, will be 727 feet high, measured from the bed of the canyon. The volume of concrete in the dam alone is estimated at 3,400,000 cu. yd.

Frank T. Crowe, of Boise, Idaho, will be general superintendent in charge of construction.

Details and Use of Metal-Forms

A new series of articles on form work, containing details and descriptions of the assembly, erection and removal of metal forms in building construction, will be started in the June issue of CONCRETE.

Many contractors do not realize the extent to which metal forms are being employed in concrete construction, nor are they familiar with the manner in which such forms are erected.

The forthcoming series of articles will explain the use of this form equipment.

***"A Single Breaker May Recede,—
But the Tide Is Coming In"***

Business is on the turn. The demand for competent men will soon be setting in. When your turn comes, here's the means to find the man you want.

AMERICAN TRADE ASSOCIATION EXECUTIVES
and
NATIONAL ENGINEERING SOCIETIES

have today rosters of surprisingly well-qualified business executives and technicians. The present emergency has made available men of splendid experience.

If and when you are in need of executives, communicate with:

American Trade Association Executives,
45 East 17th Street, New York City

Should your requirements be for professional engineers or technicians, write to one of the following:

Walter V. Brown,
Engineering Societies Building,
31 West 39th Street, New York City.

Engineering Societies' Employment Service,
1216 Engineering Building,
205 West Wacker Drive, Chicago.

This work is the free contribution of these professional organizations to industry.

Minnesota Reduces Cost of Highway Maintenance

After a steady upward march from 1921 to 1929, the period in which automobiles multiplied rapidly, Minnesota's road maintenance costs experienced their first reduction in 1930. Minnesota state highway officials attribute this lessened upkeep cost to the paving of the main routes carrying most of the heavy traffic.

In 1929 Minnesota spent $4,667,000 to keep her roads in traveling condition. In 1930 the upkeep expenditure was $4,164,000.

HOW TO DO IT

✦ **Questions and Answers** ✦
Consultation and Comment

A department devoted to the solution of problems encountered in concrete work. Readers are welcome to add to or improve upon the suggestions printed and to submit their views for possible publication.

Concrete Staves for Silos

We have been in the products manufacturing business many years, and we are considering adding concrete staves for silos to our present lines.

Is the dry-tamped or wet-cast method most commonly used, and who manufactures such equipment?—S. M. H., Baltimore, Md.

Concrete silos generally are manufactured either by the dry-tamped method or the wet-cast method, both methods giving good results.

As to machinery and molds, it can be said that machines are used for manufacture by the dry-tamped method, while with the wet-cast method the equipment consists mainly of molds and vibrating equipment.

In the dry-tamped method the machines are, of course, equipped with mechanical tampers.

In the wet-cast method, manufacturers depend on vibrating to obtain dense concrete. Some continue to employ the older vibrating methods, which produce little more than a jolting action, while others employ modern high-frequency vibrating methods, the stave units being cast on vibrating tables.

A list of manufacturers of such machinery and equipment has been forwarded.

Dowels for Joints in Road Slabs

It has been suggested to us that dowels for joints in concrete road slabs would be a worthwhile specialty for us to supply. Can you tell us something about the requirements?—O. R. W., Brooklyn, N. Y.

Longitudinal joints in concrete roads (down through the center of the pavement) are treated quite differently from the transverse joints across the roadway.

With the longitudinal joints the desire is actually to bond the two sides. In consequence, the common practice is to place ½-inch round deformed tie bars, 4 ft. long (2 ft. on each side of the joint) at intervals of 5 ft. These tie bars are placed in the center of the slab. There is nothing special about these tie bars.

In the case of transverse joints, some state highway departments omit them and permit the slab to shrink and crack where it will. The joints so formed are then filled with some bituminous material.

Most states, however, require transverse joints, and in these cases the desire is to get bond on one side of the joint and free movement on the other. In consequence, ½-inch round smooth dowels, 2 ft. long (1 ft. on each side of the joint), are placed at intervals of about 2 ft. On one side of the joint all dowels are allowed to be embedded in the concrete in the usual way. On the other side of the joint the dowels are covered with paper or tin tubes extending 2 inches beyond the ends of the dowels. Distributors of reinforcement usually supply the dowels with the paper or tin tubes, the latter being crimped at the inner ends to hold them in place on the dowel.

The requirements vary in regard to actual size and length of dowels and tie bars. Information concerning the requirements of any state can be obtained from the state highway department.

Screen Openings Expressed in Microns

In your August (1930) *issue, page* 20, *and in several instances since then, reference is made to very fine particles of cement, the sizes being expressed in microns. While I am aware that a micron is one-thousandth part of a millimeter, will you kindly give me the comparison between screen sizes and sizes expressed in microns. In other words, what micron size corresponds to the* 200*-mesh screen, and so on?—L. R., Dayton, Ohio.*

The size of the opening in the 200-mesh screen is 74 microns; in the 325-mesh screen the size of the opening is 43 microns. The latter screen is the finest regular commercial screen made, though in several instances still finer screens are made on special orders.

Lowering the Temperature of Calcination of Clinker

In the June and July issues of the Cement Mill Section of CONCRETE *you published articles on "Lowering the Temperature of Calcination" (of cement clinker), by W. C. Hansen. Is this entire subject covered in single pamphlet form? If so, where may copies be obtained?—I. H. A., Cleveland, Ohio.*

The articles to which you refer were abstracted from a separate pamphlet known as Research Paper No. 132 of the United States Bureau of Standards. Copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 10 cents each.

Concrete Pits to Resist Acids and Alkalies

Under this heading in the March issue, on this page, an erroneous statement was made to the effect that in proportioning the concrete "the volume of fine aggregate should be a little more than the volume of coarse aggregate."

The intention was to say that "the volume of fine aggregate should be a little more than *half* the volume of coarse aggregate." It is probable that readers recognized the error from the fact that in the next sentence the proportions of 1:1½:2½ were suggested as a starting point.

The Concrete Industry
—25 YEARS AGO

WITH no day's work planes permissible, according to the contract awarded him for the construction of eighteen brine tanks of concrete, it was necessary for J. C. Dumont of Detroit to build one unit a day. Twelve of the tanks were 115 by 12 by 3 ft., and 6 were 150 by 20 by 5 ft. Under his methods, the time of construction averaged 7 hours, states an item in the April, 1906, issue of CONCRETE.

"Especially devised steel molds were used. The wet mixture of 1:2:3 reinforced with corrugated bars gave entire satisfaction and left the inner surface of the tanks as smooth as glass.

"The main difficulty to be provided against was to prevent the concrete tanks from cracking and breaking. Russian sheet iron covered with sand was placed under each tank, the grains of sand acting as rollers under the expanding and contracting concrete and allowing an even movement under the entire tanks, thereby avoiding a pulling apart of portions of the concrete."

◆

CHIEFLY because of the light and graceful appearance combined with its span of 146 feet, with a spring of 18 feet, the engineering design of the bridge built at Playa Del Ray, California, by M. De Palo, for the Los Angeles Pacific Railway, was a source of interest in 1906.

Sandy ground forced the use of round pine piling about 9 in. in diameter in the foundations for each base. On the initial cast of concrete, about one foot thick, was fixed a net of rails 3 ft. 6 in. apart, to which was attached the steel armature of the three main beams of the bridge. Two of the beams form the entire facade of the bridge. The three beams are situated so that the two to which the railing is fixed give the shape to the bridge, and the third is in the center. The latter are kept together by transversal ones, 6 inches thick, but of varied height so as to conform curve and height of the three main beams.

◆

CINDER concrete, then the subject of vigorous onslaughts on the part of manufacturers of competing materials, was the subject of a discussion by J. R. Worcester before the Boston Society of Civil Engineers twenty-five years ago, and tests he mentioned are summarized in brief form in *Cement Age*.

In one, "the fiber strain in the concrete was 980 lbs. per sq. in., while the strain in the steel was 41,400 lbs. per sq. in. In the second test, "failure started from the steel being overstrained," compression in the concrete being 880 lbs. per sq. in., and the strain on the steel 60,000 lb. per sq. in."

◆

ABOUT fifty persons attended the first regular meeting of the Concrete Association of New York when it met in New York City during March, 1906.

Its president, Ross V. Tucker, referred to the necessity of establishing a permanent exhibition of concrete work in different sections of the country, the report states. W. W. Benson read letters from concrete block manufacturers in Pittsburgh, Baltimore, and Philadelphia, outlining plans and making suggestions for securing exhibition space.

Organizations

AMERICAN CONCRETE INSTITUTE; Harvey Whipple, Secretary, 2970 West Grand Blvd., Detroit, Mich.

AMERICAN CONCRETE PIPE ASSOCIATION; M. W. Loving, Secretary, 33 West Grand Ave., Chicago.

AMERICAN ROAD BUILDERS' ASSOCIATION; Chas. Upham, Engineer-Director, 914 National Press Building, Washington, D. C.

AMERICAN STANDARDS ASSOCIATION; P. G. Agnew, Secretary, 29 West 39th St., New York City.

AMERICAN SOCIETY OF CIVIL ENGINEERS; Geo. T. Seabury, Secretary, 33 West Thirty-ninth St., New York City.
Spring meeting, April 15-17, Norfolk, Va.

AMERICAN SOCIETY FOR TESTING MATERIALS; C. L. Warwick, Secretary-Treasurer, 1315 Spruce St., Philadelphia, Pa.
Annual meeting, June 22-26, Stevens Hotel, Chicago.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA; E. J. Harding, Managing Director, 222 Munsey Bldg., Washington, D. C.

BUILDING OFFICIALS CONFERENCE OF AMERICA; Col. John W. Oehmann, Secretary, 1253 Lawrence St., N. E., Washington, D. C.
Seventeenth annual meeting, April 21-24, Toronto, Ont., Canada.

CANADIAN ENGINEERING STANDARDS ASSOCIATION; 178 Queen St., Ottawa, Ontario.

CAST STONE INSTITUTE; L. A. Falco, Secretary, Chapel St. and Blatchley Ave., New Haven, Conn.

CEMENT INSTITUTE; Luther G. McConnell, General Manager, 11 East 44th St., New York City.

CONCRETE MASONRY ASSOCIATION; Jack Franklin, Secretary, 7071 Plankinton Bldg., Milwaukee, Wis.

CONCRETE REINFORCING STEEL INSTITUTE; M. A. Beeman, Secretary, Tribune Tower, Chicago.

ENGINEERING INSTITUTE OF CANADA; 2050 Mansfield St., Montreal, Quebec.

JOINT COMMITTEE ON STANDARD SPECIFICATIONS FOR CONCRETE AND REINFORCED CONCRETE; F. R. McMillan, Secretary, 33 West Grand Ave., Chicago.

NATIONAL BOARD OF FIRE UNDERWRITERS; W. E. Mallalieu, General Manager, 85 John St., New York City.

NATIONAL CONCRETE BURIAL VAULT ASSOCIATION; J. H. Stuart, Secretary-Treasurer, Bremen, Ohio.
Annual meeting, May 20-21, Neil House, Columbus, Ohio.

NATIONAL CRUSHED STONE ASSOCIATION; J. R. Boyd, Secretary, 751 Earle Bldg., Washington, D. C.

NATIONAL ENGINEERING INSPECTION ASSOCIATION; B. H. Witherspoon, Secretary, P. O. Box 1115, Pittsburgh, Pa.

NATIONAL FIRE PROTECTION ASSOCIATION; Franklin H. Wentworth, Secretary, 40 Central St., Boston, Mass.
Annual meeting, May 12-16, Toronto, Ontario, Canada.

NATIONAL LIME ASSOCIATION; Norman G. Hough, Secretary and Manager, 927 Fifteenth St., N. W., Washington, D. C.
Thirteenth annual convention, June 3-4, White Sulphur Springs, W. Va.

NATIONAL READY-MIXED CONCRETE ASSOCIATION; Headquarters, 27 Barbeau St., Pittsburgh, Pa.

NATIONAL SAND AND GRAVEL ASSOCIATION; V. P. Ahearn, Executive Secretary, 432 Munsey Bldg., Washington, D. C.

NATIONAL SLAG ASSOCIATION; H. J. Love, Secretary-Treasurer, 937 Leader Bldg., Cleveland, Ohio.

NATIONAL TERRAZZO AND MOSAIC ASSOCIATION; U. F. Durner, Secretary, 809 St. Paul Ave., Milwaukee, Wis.
Annual convention, April 27-30, Biltmore Hotel, Atlanta, Ga.

NORTHWEST CONCRETE PRODUCTS ASSOCIATION; W. P. Hews, Secretary-Treasurer, Yakima, Wash.

PORTLAND CEMENT ASSOCIATION; William M. Kinney, General Manager, 33 West Grand Ave., Chicago.

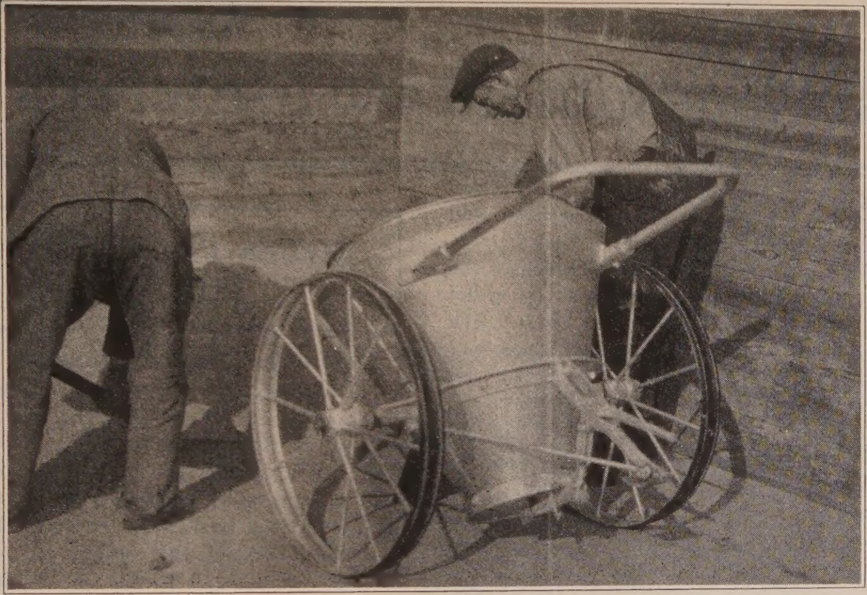
RAIL STEEL BAR ASSOCIATION; H. P. Bigler, Engineering Secretary, Builders' Bldg., 228 N. La Salle St., Chicago, Ill.

WISCONSIN CONCRETE PRODUCTS ASSOCIATION; Jack Franklin, Secretary-Treasurer, 425 East Water St., Milwaukee, Wis.

New Equipment and Materials

KoneKart Simplifies the Handling of Bulk Cement

The Johnson KoneKart, designed to make bulk cement handling by the contractor more profitable, has a large top opening for fast filling, and a support to allow a lower shoveling height by tilting back the KoneKart.



A toggle locked valve provides a bottom discharge which, when used with a canvas spout, avoids the splashing and blowing of cement caused by dumping a tip-over cart into a truck compartment. The valve is tripped and the cement pours into the compartment smoothly and evenly.

The KoneKart is of galvanized steel construction with smooth, steel sides, and is available in three sizes for varying mixer batches. It is manufactured by the C. S. Johnson Co., Champaign, Ill.

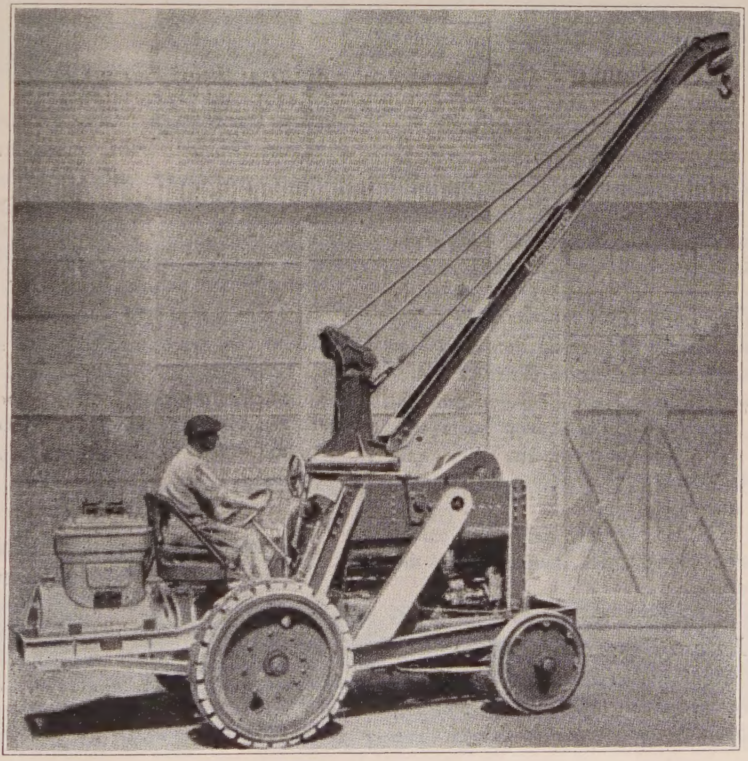
Congested Working Space No Handicap to the Loadomaster

Compactness, ready mobility, and easy operation are three features of the Loadomaster swing-crane. Besides being able to hoist, swing and transport moderate loads, the unit can haul trailers, even while carrying a load in suspension. It can pass through an opening 66 inches wide and requires only 8 ft. 10 inches head clearance. A single operator handles every control.

Contractors, public utilities, railroads, industrial plants, and municipalities are among those already using the Loadomaster successfully, according to Frederic H. Poor, Incorporated, New York City, who manufacture it.

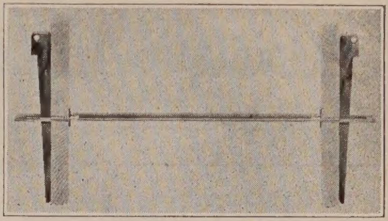
The swinging boom affords maximum facility in the spotting of loads. Stiff legs are unnecessary for handling loads over the side, stabilizers connected with the front axle and operated by a single lever from the driver's seat serving this purpose.

A 160 cu. ft. compressor, mounted as a part of the unit, can also be supplied for working drills, hammers, etc.



Economy Wedge-Spacer Tie Saves Time, Labor

A new, simple way of tying wall forms is made possible by the Economy wedge-spacer tie for wall forms. Its features make it possible to build forms rapidly, spacing and tying them without nailing, and to wreck them quickly, with greatest amount of salvage, it is said.



Studs are used 4 to 5 feet apart on one side of the forms. One nail for each board is said to be adequate for rigidity in aligning and bracing. The wedges form a continuous steel stud on both sides of the wall, gripping the boards firmly against spreader flanges. The steel stud line holds the forms firm when boards are spliced at any point.

Wedges are shaped so as to be easily removed and to quickly release all form boards. The ties are manufactured of

⅝ by 16 gauge high tensile band iron and are said to hold a pour of 3 ft. per hour at 60 deg. F. with ties spaced 2 ft. apart.

The Economy wedge-spacer tie is a product of the Fischer & Hayes Rope & Steel Company, Chicago.

Pulverized Iron Waterproofs All Types of Concrete

Waterproofing all types of concrete, both old and new, interior or exterior, with pulverized iron is one of the most simple and convenient methods, according to the National Waterproofing Company, Chicago, Ill. The iron, finely pulverized, is mixed with water and applied with a brush.

Another use for the iron is in the repair of broken walls and floors and the filling of cracks, to create a perfect bond between the old and new material. For the patch itself some iron is mixed in with the usual concrete ingredients.

When employed as a floor hardener, slightly larger particles are used. For this purpose the iron is scattered over the top coat before it has set and then troweled in, resulting in an oilproof, waterproof and dustproof surface. An instance of its use in this way is in the Merchandise Mart in Chicago, where a carload and a half was used.

The water in the mixture when it soaks into the concrete carries the fine iron particles along with it and when they rust they swell up to several times their former size, sealing up the pores completely. As iron oxide or rust has little or no tendency to change, it does not deteriorate with age and a wall or floor waterproofed with this material will remain waterproof permanently, it is stated. This coating of rust may be covered by a plaster coat troweled on or by a brush coat of pure cement mixed with water.

About Makers of Equipment and Materials

INDUSTRIAL LITERATURE

Character of Nailcrete

General information about Nailcrete blocks and their manufacture is made available in a 4-page folder issued by the *Nailcrete Corporation,* New York City.

Such factors as stabilized nailability, strength of blocks, and functions of Nailcrete voids are explained, as are also the origin, composition, treatment of aggregates, character of Nailcrete, and its functions in manufacture.

A single page enclosure which accompanies the folder is prepared for distribution by the individual manufacturer of Nailcrete and gives information desired by the purchaser.

Vibro-Cast Concrete

The Biggest Step Forward Ever Made in Concrete is a 16-page booklet just published on the use of Vibro-Cast equipment for securing the highest yield of concrete per bag of cement at the strength specified.

The greater portion of the booklet is occupied by practical instructions outlining clearly and fully the application of Vibro-Cast machines in concrete placing. Structures and structural parts covered are columns, tunnels, flat slabs, deep beam sections, pipe line encasements, thin wall sections, concrete products such as pipe, piles, and cast stone.

The Electric Tamper and Equipment Company, Chicago, Ill., manufactures the equipment.

Latest Besser Strippers

The latest type Besser stripper machines are described in an 8-page leaflet pointing out especially their improved design. The Super stripper, the Standard stripper, and the Victory stripper are included. Entirely automatic, the machines deliver the unit to the front and lay it on the pallet without the aid of human hands. The machines, the Besser Company states, will make more block per sack of cement and at a lower labor cost than any other machines on the market heretofore.

All three machines are constructed on the same principle, differing only in such details as make them best adapted and most economical for the speeds at which they are designed to operate.

Each one of the three strippers is built to withstand considerably more than its rated capacity would require, the *Besser Manufacturing Company,* Alpena, Michigan, states.

Multiplex Machinery Catalog

A looseleaf catalog of 38 pages, just issued by the *Multiplex Concrete Machinery Company,* Elmore, Ohio, covers Multiplex concrete machinery, including the automatic power feed tamper and stripper, the Junior single block power press stripper, Junior stripper, power stripper tile machine, and the double stripper.

The balance of the publication is devoted to the hand-operated units such as the single block stripper hand press, stripper tile machine, and to flue block machines and equipment for them. The step and lintel mold is also shown and described.

Air-Driven Tool Broadside

Turbine air-driven tools manufactured by the *Tousley Tool Company,* Cleveland, Ohio, are shown in a new broadside. Included, among others, are concrete surfacers, drills, grinders and saws. The turbine air motor is described and its efficiency-making features listed.

NOTES FROM THE FIELD

Vehmeyer Detroit Manager

Joseph T. Ryerson & Son, Inc., announce the appointment of *E. M. Vehmeyer* as manager of their Detroit plant.

Mr. Vehmeyer comes to this position with a background of many years of experience in the steel-service business. He has been associated with the firm for over 22 years. The major portion of this time has been spent in the sales and service departments. For the last two years he has held the position of sales manager in the Detroit plant.

W. H. Basse, formerly Detroit plant manager, has been transferred to Chicago, where he will engage in special sales work.

Danish Engineers Reorder from Butler

The Butler Bin Company, Waukesha, Wisconsin, has recently received an order from Monberg & Thornsen, engineers of Copenhagen, Denmark, for two 20-yard steel bins equipped with measuring hoppers to be used in building an extension for the Danish National Railroad.

This is the second order and installation placed with the concern within the past two years.

American Makes Preformed Rope

The American Chain Company, Inc., in its annual report to its stockholders, has announced that one of its subsidiaries, the *American Cable Company,* has concluded negotiations with the *American Steel and Wire Company* to manufacture preformed wire rope under a license agreement, the patents covering this material being owned by the American Cable Company.